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ENGINEERING AND MINING JOURNAL

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MINE EQUIPMENT

Park Utah Consolidated's
New Tipple

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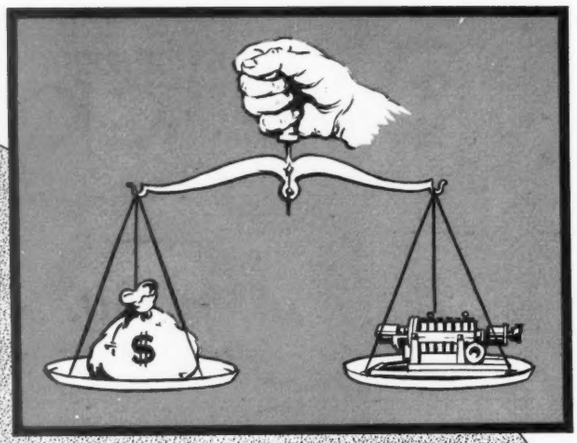
NEXT WEEK: *How Prosperous Is the Metal Mining Industry?* . . . BY A. B. PARSONS



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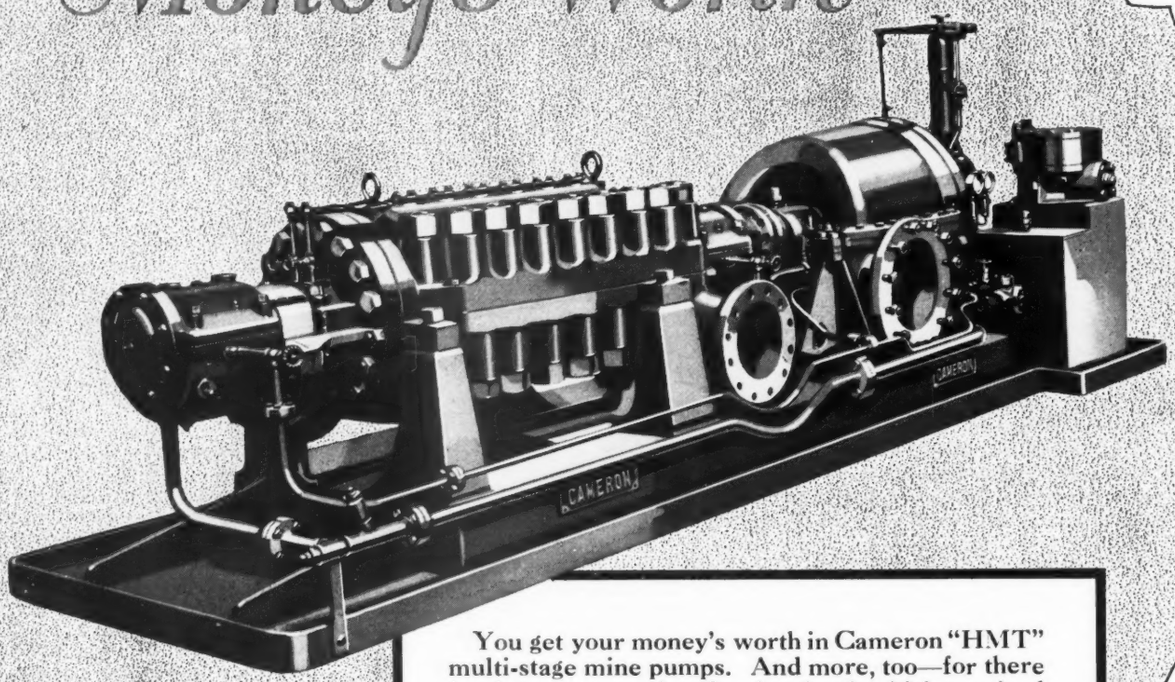

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Determination of Ultimate-Consumer Demand

TWO ENTIRELY different subjects discussed at the recent meeting of the Chamber of Commerce of the United States at Washington are capable of joint consideration. The first referred to group enterprise, and the second to forecasting and planning as a function of group management. Mr. R. F. Pack, vice-president of the United States Power Company, of Minneapolis, prefaced his remarks by insisting that group enterprise is fundamentally and economically sound in that it permits the use of the best machinery for organizing and utilizing the highest-quality human ability. Mr. Pack discussed the application of the principle in the public utilities field, but many of his comments are pertinent in the consideration of the functioning of other industries. Group purchasing, he maintained, makes lower prices possible. Group insurance permits the writing of one blanket policy protecting all properties, at a rate far lower than could be secured otherwise. In financing, however, group enterprise offers distinctive opportunities that place the unattached unit at a serious disadvantage. In summary, Mr. Pack maintained that group enterprise accomplishes a material saving, which is passed along to the ultimate consumer, and it makes available to the smallest unit in a consolidation the best brains and the highest type of skill that can be secured. Group management is therefore interpreted as of material benefit to the public.

Although some mining operations lend themselves to group control, many, to survive, must persist as individual units, hampered in their progress by an inability to take advantage of the benefits enumerated, in addition to those arising from diversification of interest and centralized research. These must therefore turn in greater degree to the government agencies provided to help them in their problems. To the larger group enterprises, therefore, benefiting as they do by obvious advantages, falls a major part of the responsibility for advance in that particular industry; and this brings the matter within the scope of the subject of the second paper discussed at Washington, on forecasting and planning, presented by Mr. Donaldson Brown, vice-president of General Motors. Disregarding the technicalities of the procedure adopted in his organization, Mr. Brown stressed the need to study demand from the ultimate-consumer standpoint. Constructive forecasting, he maintained, involves consideration of long-term as well as short-term factors. Mr. Brown was careful to show that his company recognizes and distinguishes the benefits that come from a systematic measurement of consumer demand and those that result from forecasting and planning. In other words, a consistent rate of output, based on a scientific study of demand, involves minimum waste. Research is undertaken to disclose avenues for increasing consumer appeal.

These basic principles can be applied to other industries. Mr. Brown goes afield for an illustration, and depicts what may and what should happen in the cotton yarn industry. In essence his theorem is "From the standpoint of the stabilization of the industry, a desirable production rate of every stage in the chain should be determined by the state of demand of the ultimate consumer, not by what the demands of the succeeding stage may happen to be. The problem involves co-operative effort, and this means untiring research."

So many investigations have been made that one may well hesitate to suggest avenues for the increased use of the non-ferrous metals. As an example of stray inspiration, however, it might be mentioned that, as a preliminary to considering the reconditioning of one of the large passenger ships taken from the Germans during the war, a test was made to determine the thickness of the hull. Boring proved that the condition of the plates was excellent. A metallurgical analysis revealed the fact that copper-steel had been used. To those interested in the increased sale of copper, a research would seem pertinent, with a tentative forecast as to the amount of red metal needed if the ultimate economy in the use of the alloy could be established and a favorable attitude encouraged on the part of steel fabricators and ship builders. Forecasting and planning, as distinguished from recognized consumer demand, should be an appropriate function of group industrial enterprise.

Development of a New Principle in Filtration

ANNOUNCEMENT in a recent issue of the U. S. Patent Office *Gazette* that an automatic rotary filter of the paddle type had been invented by Dr. H. S. Hele-Shaw and Messrs. R. C. B. Stillman and J. A. Pickard, of London, follows closely on the appearance in the *Mining Magazine* for March of an article by Mr. Pickard on stream-line filters and separators. The patent specifications are not informative as to the class of material the new filter is intended to handle, but the machine evidently embodies the stream-line principle. Mr. Pickard states in his article that such a filter is now working on heavy sludges in England and could be adapted to deal with slimes and flotation concentrates.

Stream-line filtration, a novelty as yet to many, was discovered accidentally by Doctor Hele-Shaw in 1922. As recounted by Mr. Pickard, researches on the stream-line flow of liquids were being undertaken. Colored liquids

were passed in thin films between blocks of plate glass separated a distance equivalent to the thickness of a thin piece of paper. Some of the liquid percolated through and came away by an irregular route at the edges, but it was noticed that the effluent was colorless. The next step was to take advantage of the discovery. Small filters were made by assembling, in a column, thin, waterproof paper washers, with a hole in the center of each, the "pack" numbering about 500 to the inch of thickness. The material to be filtered was then forced through the center hole, the pack being held together by pressure. In this manner the effect previously observed was multiplied. Eventually, success was achieved, especially in cleaning lubricating oil.

Further development ensued, and a commercial filter was devised. However, a difficulty in practical application was that of disposing of the accumulated solids. This was overcome by causing them to accumulate on the outside of a flat-surface, strip-type filter, developed from the block type. The development of this flat-surface type unit made possible the application of the stream-line principle in the filter press and in the automatic, self-cleaning vacuum filter of the rotary type.

Essentially, the novelty in the new method of filtration consists in passing the liquid to be filtered between layers of an impermeable medium, instead of through the pores of a permeable medium. In spite of the soundness of the fundamentals underlying the new invention, and the skill and science applied in the development of the commercial machines, it would not appear that stream-line filtration offers much of interest to those concerned with the dewatering of ground ore or metallurgical products, although an open mind toward any technical development of this character is desirable. Actual comparative data on the operation of stream-line and normal filters would prove interesting and suggestive.

More Knowledge Needed of What We Buy

HOW much fundamental information regarding the quality of manufactured articles should a potential buyer and consumer be given? Not long ago a book was published entitled "Your Money's Worth," which has since attained the popularity of a "best seller." The lesson the authors endeavored to teach the ultimate consumer was (1) that many branded goods are sold at exorbitant prices if valued in relation to cost of production and to comparative advantages in use; (2) that a consumer should be taught what are the most desirable characteristics and compositions of the goods he buys; and (3) that governmental or private agencies should be established to formulate specifications for standard articles, by which the consumer would be guided in his buying.

Such a plan has obvious advantages. It would go a long way to encourage the dissemination of definite and supportable reasons why, for instance, the public should buy a particular type of lubricant, instead of suggesting that So-and-So's motor oil should be put in one's automobile because spring is coming. It should result in a lower price to the consumer, as a result of reduced cost of distribution.

Objections could no doubt be offered, and yet *Engineering and Mining Journal* feels that a manufacturer could go much further in offering more convincing reasons for the use of his products, and that governmental agencies need not lean over backward in their policy of withholding information that would make for more intelligent purchasing.

Consider, for instance, the universally used items of motor oil and gasoline. Did the reader ever see an advertisement in which scientific reasons were given, supported by actual data from complete tests by independent technical organizations, showing why one particular gasoline or motor oil offered for sale was better than another? No; the manufacturer merely says "Buy our gasoline for quick acceleration and minimum fouling of your motor; buy our motor oil instead of cheap oil and contribute to the long life of your car. A grade for each model, as shown in the accompanying table." All generalizations; no definite points of superiority that would appeal to an intelligent man.

And do the authorities give any help? The United States government issues a bulletin every year giving the results of tests, which show that some kinds of gasoline are of much higher quality than others—results that are useless to the consumer unless he is prepared to go to the expense of numerous tests on individual brands, to interpret the government figures. A request to the government for more detailed information brings the reply that fairness to manufacturers has made necessary an ironclad rule that names be not disclosed under any circumstances. Why would this be unfair? Would it not be fairer, not only to the vast army of consumers but to the manufacturers as well, to make known the names of those turning out the products corresponding to the various tests?

It need not be said which product is best; let the intelligent reader decide for himself. The Canadian Department of Mines does this. Physical tests are given, in its Gasoline Survey for 1927, with the brand name and the name of the producer, for 83 different samples of commercial gasoline. The Canadian motorist has no excuse for buying blindly, and the maker of a superior product gets due credit. Cannot a similar plan be adopted in the United States?

The Discovery of Gold in California

FEW who have given the subject the usual cursory attention will have realized that so lengthy an account could be written about the discovery of gold in California as that recently published in the University of California *Chronicle*, from the pen of our esteemed colleague, Mr. T. A. Rickard, and reprinted in a booklet of 30 pages. Written in a style that exemplifies clarity and directness of phraseology, the account reminds one of a saying—was it Walter Pater's?—as to "the aesthetic charm of mere clearness of thought." Mr. Rickard has made a painstaking analysis of historical records before committing himself; and, in spite of the apparent thoroughness of his treatment of the subject, he invites correction or criticism, which indicates a commendable attitude.

Contrary to popular impression, the discovery of gold in California antedated Marshall's exploit in 1848. The author of "A System of Mineralogy," published in Edin-

burgh in 1816, stated that "On the coast of California, there is a plain, fourteen leagues in extent, covered with alluvial deposits, in which lumps of gold are dispersed." In 1844 the deputy for California in the Mexican congress confirmed this report, maintaining that "The mining interest in California is of greatest importance. . . . On my departure from that town [Los Angeles] in December, 1843," he adds, "there were in circulation about 2,000 ounces of gold, which had been extracted from the above-mentioned placer, the greatest part of it destined to go to the United States." The goldfield, Mr. Rickard avers, was probably near the Santa Feliciana canyon, 40 miles northwest of Los Angeles.

"Such early discoveries of gold during the Mexican regime," one reads, "attracted no attention in Europe, or even in the United States, because the local officials had every desire to prevent publication of the facts; the *hacendados* deprecated anything that might take the laborer from their fields and gardens; the Franciscan padres suppressed the information because news of gold mining would bring a horde of new settlers, *Americanos*, who would dispute their dominance and maltreat the Indians. Both were correct in their anticipation, as was proved when the great rush ensued a few years later."

In 1846 the U. S. Consul at Monterey, in a communication to the Secretary of State, averred that "There is no doubt but that gold, silver, quicksilver, lead, sulphur, and coal mines are to be found all over California; and it is equally doubtful whether, under the present owners, they will ever be worked." His unintelligent opinion and careless phraseology doubtless bred a spirit of pessimism at Washington as to the metal and mineral potentialities of California.

One may wonder why the Spaniards in the sixteenth century neglected California in their wide search for treasure, but Mr. Rickard explains that the *conquistadores* of Mexico and their immediate successors "limited their explorations northward to the region now known as Arizona." A prospecting expedition was ordered by the viceroy in 1540, but natural obstacles proved insurmountable. The Bay of San Francisco was "discovered" by Portolá late in 1769. "The Seven Cities of Cíbola, the golden land of Spanish myth," Mr. Rickard chronicles, "lured the adventurers into the wilderness repeatedly, but all that they found were the mud hovels of the Indians; they failed in their search, because the gold was beyond the desert and across the mountains of their farthest horizon, and there it was to be found not in the jeweled cities that Estevanico had reported, but in the gravel of the mountain torrent and in the quartz that veined the ramparts of the Sierra Nevada."

The Marshall discovery of gold near Sacramento, on Jan. 24, 1848, occurred nine days before California was ceded to the United States by Mexico, when neither government knew of the find. Mr. Rickard describes, with a detail that is justified by the dramatic interest in the happenings and by the skill he uses in the telling, this event and its aftermath. Early technology is not neglected. One could quote exhaustively from the account, but space forbids. If the reader's appetite has been whetted by this brief review of the opening paragraphs of a monograph on the antecedents to and the consequences of an important event in the history of the United States and of the mining industry, he is promised full satisfaction when opportunity arises for a leisurely browse through the complete account. Mr. Rickard is performing a valuable service to his contemporaries and to posterity in assembling data of this character, sifting the wheat from the chaff, and presenting a summary in well-balanced perspective as a scholarly yet most readable historical document.

The Supreme Court Upholds the Flexible Tariff Law

THE RIGHT of the President of the United States to increase or decrease the rates of duty on imports by as much as 50 per cent from those prescribed in the tariff act of 1922, and the constitutionality of "protecting" American industries by laying a tariff barrier, were both upheld by the Supreme Court in a decision delivered by Chief Justice Taft on April 9. It is well to have each of these matters cleared up, although perhaps few people seriously questioned the legality of the present laws on these subjects.

The case under review concerned the importation of barium dioxide, on which a duty had been fixed by the tariff act at 4c. per pound. The Tariff Commission found that this duty was not sufficient to equalize the cost of production between the United States and Germany, and, as a result of the findings of that body, the President increased the tariff to 6c. per pound. An importer questioned the decision, the case being successively carried before the U. S. Customs Court, the Court of Customs Appeals, and finally the Supreme Court, all of which upheld the legality of the tariff increase. The contention of the importers—that this delegates a legislative power to the President that according to the Constitution should be vested in Congress—was declared without weight, because the President, with the assistance of the Tariff Commission, was merely delegated to execute an act of Congress with given limitations, as clearly stated by Congress; and that this delegation of authority was similar to that conferred upon the Interstate Commerce Commission in the fixing of rates charged by railways. It was admitted, however, that the determination of the difference between the cost of production in the United States and that in foreign countries is largely guesswork. The second contention was that a tariff cannot be levied for protection but for revenue only, the Constitution providing that "The Congress shall have power to lay and collect taxes, duties, imposts, and excises, to pay the debts and provide for the common defense and general welfare of the United States." The Supreme Court showed that according to long precedent and general understanding there was no basis for this argument. It seems strange that such a thoroughly recognized principle of the Republican party should be questioned at this late day.

The flexible provisions of the tariff act have so far not been exercised in behalf of the mining industry. To be sure, barium dioxide might be considered a product of the mining industry, and gold leaf, the duty on which has also been advanced, is certainly one of the final products of mining, but these tariff increases will not affect the prosperity of the field in which *E. & M. J.* is interested. Under a Republican administration, the flexibility of the tariff has, of course, largely been upward, though duties have been reduced on bran, taximeters, paintbrush handles, live bob-white quail, and cresylic acid. Among the varieties of the last-named commodity, the crude grade, as used in flotation, was carefully excluded.

Train of cars being dumped and ore being loaded from discharge of pan conveyor into railroad cars

The New TIPPLE *of the* PARK UTAH CONSOLIDATED

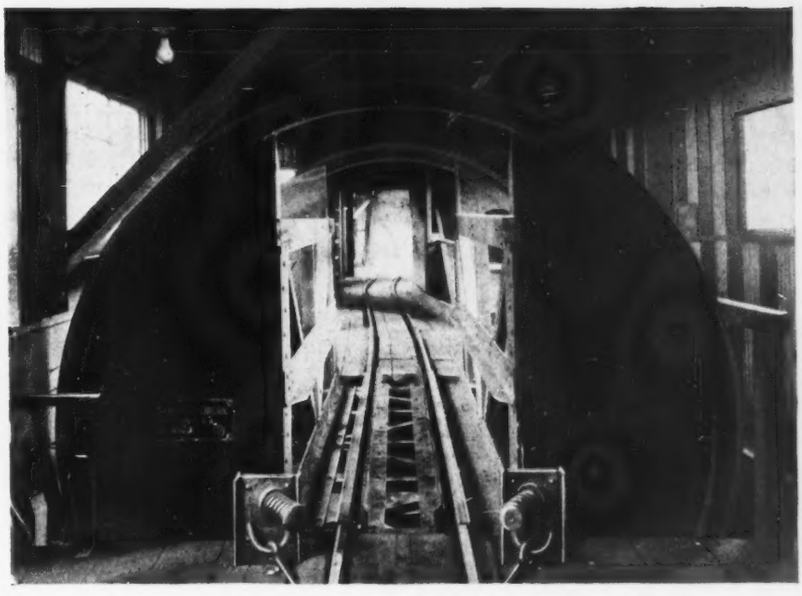
By H. D. KEISER
Assistant Editor
Salt Lake City

A NEW tipple installation, effectively reducing labor costs, was placed in operation recently by the Park Utah Consolidated Mines Company at its Ontario portal, which serves the west side of the company's Park Utah unit, and is situated at Keetley, Utah. The essential features of the installation are a Wellman-Seaver-Morgan car tipple and a steel pan conveyor, dumping direct into standard railroad cars placed on either side of the tipple. At present three men are employed in the tipple crew, but this force will be reduced to two within a short time. Under previous ore-loading conditions ten men were required.

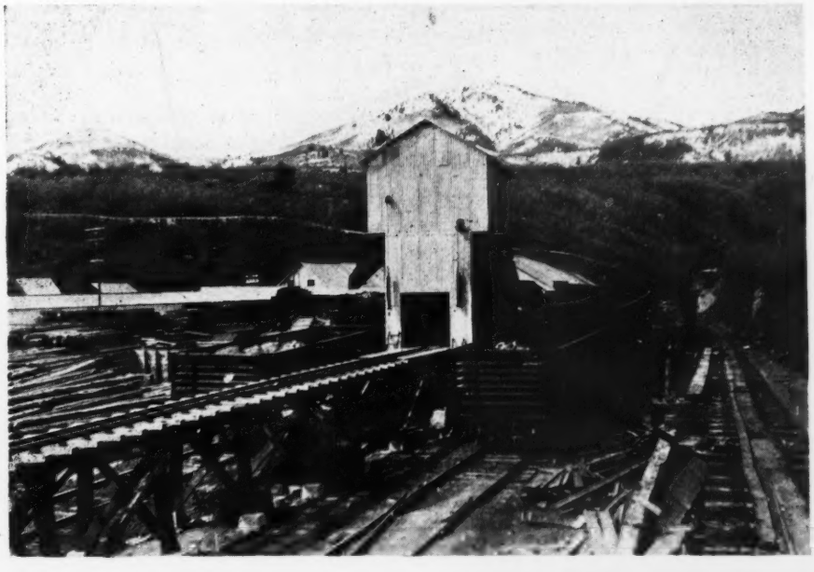
Ore car in the tipple just after being dumped

ELECTRIC locomotives, each consisting of two four-ton Westinghouse-Baldwin units in tandem, haul the ore to the tipple in trains of seventeen cars over 18-in. gage haulage lines. The cars, which were built at the Judge shops of the company, have a capacity of 68 cu.ft., or about five tons of ore. They are equipped with one swivel and one stationary coupling.

The car tipple, which is electrically operated and requires but 7½ hp., has an actual dumping time of 15 seconds per car. In dumping one of the trains of seventeen cars only nine minutes is necessary, this period including the time for moving each car on and off the dumping platform. The tipple is 12 ft. long, 9 ft. 9 in. in diameter, and weighs 13,000 pounds.



Car tipple in horizontal position



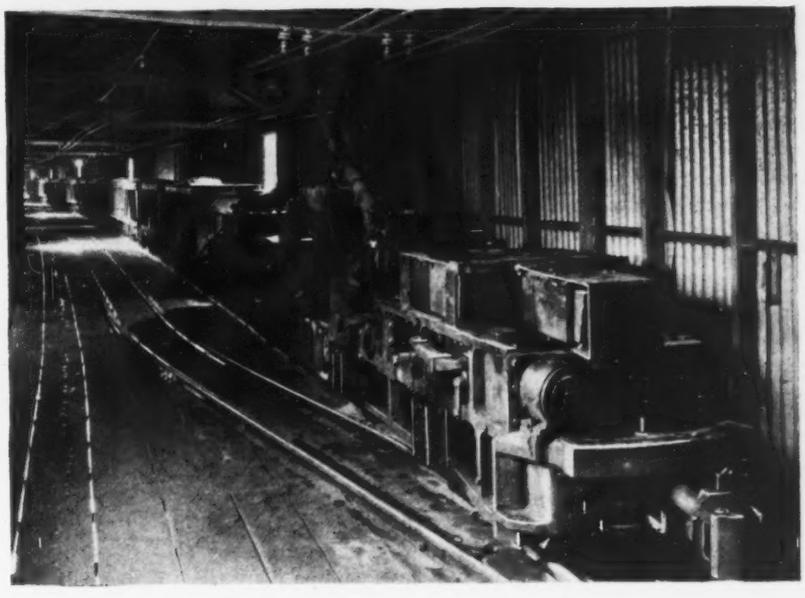
Exterior view of the tipple with railroad cars spotted for loading

One of the 17-car trains approaching the tipple

ORE dumped from the cars at the car tipple falls on a steel apron and passes by gravity to the steel pan conveyor traveling at 90 ft. per min. This elevates the ore about 27 ft. above the ground level and dumps it into 60-ton railroad cars alongside the tipple for transport to the smelter.

About 500 tons of ore is being loaded daily, but the installation has a capacity of 1,000 tons per nine-hour shift. Operations at the tipple are in charge of W. S. MacFarlane, master mechanic.

The Park Utah company, which is the largest and most important operator in the Park City district, has steadily been improving its plant and equipment to insure itself the proper facilities for the future expansion of mining operations and to enable it to maintain its desired production.



The Rôle of Paint in Plant Lighting

As an Aid to Increased Illumination

IF THE plant interior is poorly lighted, the color scheme involved in its decoration should be considered before attempt is made to rearrange the lighting system or to replace the electric bulbs with stronger ones. Inspection may show that the ceilings, walls, and floors are so dark in color that most of the light falling on them is absorbed; and that, owing to lack of reflected light, shadows cast by machinery and other objects are deep and black. Glare may also exist. Repainting may offer a sufficient remedy.

By A. H. HUBBELL
Associate Editor

IF THE average mill superintendent could lift the roof off his plant and let in the daylight he would probably get some new ideas. In fact, he might see some things that would set him thinking along unusual lines. Of one thing we may be certain—he would be much less pleased with himself than he had been before, unless his plant was very much above the average. Daylight shows conditions in their true light. Artificial light is never quite as good. Dusk and gloom and deep shadows may add to the artistic value of the mill interior, but, as a certain foreman said, on tearing down some circus posters, "Who wants art about a mill?"

The value of light as a revealer of defects was impressed forcibly upon the writer some years ago when traveling through the mining camps of the South. Arriving in a certain small town after sundown, he strolled through the shaded residential streets. The moon was shining through the trees. The air was fragrant with roses and honeysuckle. Lights gleamed from the homes set in the shadows. A perfect setting for somebody's "old Kentucky home" it seemed. Early the next morning, out again for another sight before the serious business of the day, he was rudely shocked. The roses and honeysuckle were there, the shrubbery and the trees, but the romance had departed. One and all, the houses were dilapidated and in need of repair and, above all, in need of paint. Nothing would have helped that town so much as a liberal coat of paint.

But adequate illumination plays a more important part about a plant than that of simply revealing dirt, disorder, and dilapidation. Poor light is a decided handicap in operation. It is responsible for fully one-quarter of the avoidable industrial accidents that happen annually in the United States, according to trustworthy estimates. Many falls and fractured limbs are directly caused by it. More casualties take place in the short winter days than in the summer time. Oilers are caught by line shafts and other moving parts as often because the light is poor as because they are careless or preoccupied.

Tests in manufacturing plants have shown that the quality of the lighting has a bearing on production. The movements of an operative about a machine are surer and quicker, and his efficiency is correspondingly greater, if the light is good. Spoilage is decreased. All this is just as true of mine shops. Repair work in mills, crushing plants, and smelters is similarly affected.

Good lighting, moreover, has a psychological effect upon workmen. All things considered, the well-illuminated plant is a better and more attractive place to work in than one that is poorly lighted.

These remarks are almost platitudinous. Every plant superintendent will at once agree with them. The question may be asked, therefore, why do so many companies fail to illuminate their plant interiors properly.

Requirements of Good Lighting

Before going further into this phase of the subject it is well to consider the requirements of good illumination. These may be listed[1] as follows:

1. The light must be steady and of an intensity sufficient for requirements on all working surfaces.
2. The light on walls near a working area must not vary greatly in intensity from that on the working area. The purpose of this stipulation is to avoid straining the worker's eyes through the sharp focussing that a strong contrast in the intensity of light on the two areas would necessitate.
3. The light must be suitable in color and specular character.
4. Glare must be avoided.

With the requirements of good lighting in mind, one may seek the causes of poor illumination. Obviously, in any specific case the cause will lie in the failure to meet the requirement.

Illumination may be obtained with either natural light or with artificial light. Inadequate window space of course will result in failure to admit sufficient natural light, a defect that can be remedied only by cutting more

[1] "Principles and Practices of Upkeep Painting." Chapter 21. E. I. duPont de Nemours & Co., Inc. Also "Don't Handicap Your Lighting System," *Industrial Management*, January, 1927.

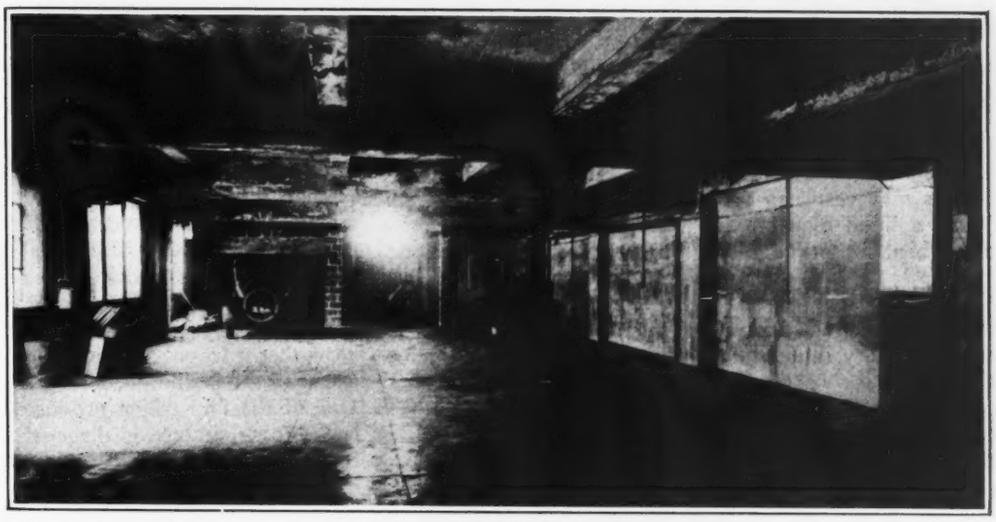
openings for windows or by depending more on artificial light than would otherwise be necessary. For the purpose of the further discussion of this subject it will be assumed that the amount of window space is adequate to admit sufficient light in daylight hours for proper illumination without recourse to artificial light if the light be properly conserved; and that the artificial lighting system is adequate with respect to power and to layout for proper lighting at night if the light be properly conserved. The topic for discussion is thus narrowed down to this: How shall proper use be made of the existing light supply? Under correct conditions this supply will be entirely adequate. What are those conditions? The question, it may be said, is largely one of paint.

The principal causes of poor illumination under the conditions given are, first, the failure to use the light-reflecting possibilities of walls and ceiling; and, second, the concentration of light.

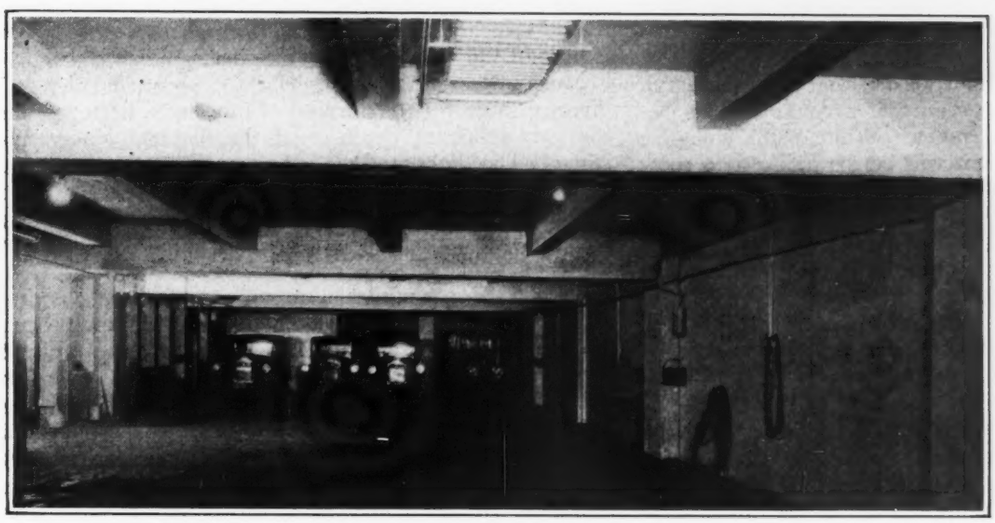
As to the first, every horizontal and vertical surface in an interior absorbs part of the light, artificial or natural, that falls on it. The smaller the amount absorbed, the more efficient will be the lighting system. To avoid going unnecessarily into the theory of absorption and reflection, we may dismiss the subject by saying that dark surfaces absorb the light (this being why they are dark) and light surfaces reflect it. To correct a dark surface so that it will reflect a greater proportion of the light that falls on it we must paint it with some light-colored paint. Maximum reflection—that is, about 80 per cent—may be obtained by using white paint. Here it may be stated that block carbonate of magnesia, reflecting 98 per cent white light, is generally accepted as the standard of whiteness. Many so-called whites in comparison with this standard are really light grays. The effectiveness of other colors as reflectors may be judged from the figures given in Table I.[2] A writer in *Industrial Management* places ivory after white, with a reflection of 70 per cent of the light that falls on it; then buff, with 65 per cent; medium gray paint, with 35 per cent; olive green paint, with 20 per cent; and brown, with 15.

Aluminum paint has high reflectivity. This may run up to 70 per cent. Furthermore, owing to the nature of the pigment in the paint, its reflectivity is remarkable for its durability. It attains practically its maximum reflectivity in one coat, no matter what the surface. Moreover, it offers high resistance to the action of sulphur compounds.

The superintendent therefore who believes that more light about his plant would improve it would do well to



Before painting. The interior of a company garage.



After painting walls and ceilings with a paint of high reflectivity

[2] M. Rea Paul: "Increasing Factory Efficiency by the Proper Use of Paint." Ninth Annual International Purchasing Agents' Convention, Boston, May 22, 1924.

consider the color scheme, if there is one, of his interior before ordering more and stronger electric bulbs or having the artificial lighting system rearranged. Inspection may show that the ceilings, walls, and floors are so dark in color that most of the light falling on them is absorbed;

Table I

Color	Approximate Percentage of Reflected White Light
White	75 to 84
Cream	60 to 80
Yellow	60 to 75
Buff	50 to 65
Yellow-green	50 to 70
Light red	35 to 55
Light blue	35 to 50
Grays for ordinary wall work	15 to 65

and that, owing to the lack of reflected light, shadows cast by machinery and other objects are deeper and blacker than they otherwise would be. More than this, he will probably find that as a result of the proximity of dark walls to strongly contrasting light window spaces, a condition of glare is brought about in places at certain hours of the day. Such contrast in light necessitates frequent refocussing of a workman's eyes. Temporarily he is blinded by the light or by the darkness. Such conditions may result in accidents of various sorts. Who wants a blind man on the job? Why blind the workman, then, from time to time through faulty illumination?

Selecting the Color—Functions of Paint

The inquisitive superintendent who undertakes thus to study a faulty illumination scheme will quickly perceive the advantages of lighting things up with paint. What color shall he use? White will give him maximum reflection. But white has its disadvantages. What other factors must be considered? This brings us to a consideration of the functions of paint. These are:

1. To protect the materials painted from corrosion or decay.
2. To hide soiling and mechanical injury.
3. To lighten the surroundings.
4. To make surroundings cleaner and more cheerful.

Immediately it will be seen that a conflict exists between some of these purposes. White paint will give the best illumination, but it will be the quickest to show dirt and injury. Black paint, on the other hand, gives the minimum reflection or none at all, but shows soil and abrasion least. For the purpose of covering iron and steel surfaces, moreover, black pigment is unsuitable, because, owing to the similarity in color of the paint and the metal, blemishes in painting are not easily discerned. Points of varying weight for and against the use of other colors in between these extremes of white and black may be cited.

Some compromise is therefore advisable between the desire for maximum conservation of light and the desire for a paint that will show soil and injury the least. This may be effected by painting the lower portion of the walls, say to shoulder height, a color sufficiently dark to conceal dirt and markings, and painting the remaining portion of the walls, the ceiling, and the roof trusses with a color that will reflect most of the light that falls on them. A white or some light tint is best suited for this purpose.

White paints are harder on the eyes than tinted paints, according to G. W. Thompson (*Architectural Forum*, May, 1920), and therefore probably do not have the high effective illuminating value attributed to them, inasmuch as this value is limited by the physiological limitations of the eye. He means that excessive illumination may cause the pupil of the eye to contract, thus cutting down the amount of light reaching the retina and making the illumination actually less efficient. He argues that illumination in general should be such that the pupil is neither unduly contracted nor dilated.

At any rate, either a white or some other color having high reflecting power should be chosen for the upper part of the walls and for the ceiling. Grays are commonly used for the dado, as the band around the lower portion of the wall is called. Aluminum paint serves admirably for this purpose. In some plants aluminum paint alone has been used for covering the walls and ceiling. In addition to its high and durable reflectivity it possess remarkable hiding power. Hiding power may be defined as the ability to obscure or conceal the old, dirty, or dark-colored surface. Aluminum paint owes this quality to the opacity of the metal flakes.

Gloss vs. Flat Finish

Another question involving the illuminating value of paint is whether a gloss paint or a flat paint should be selected. The difference between the two lies in the proportions of pigment and vehicle used in the mixture. A flat finish is obtained by using a relatively large amount of pigment and a correspondingly small quantity of the vehicle (say linseed oil). The oil is just sufficient to bind the particles of pigment together and fasten them to the surface painted; the surface of the paint film is mostly pigment. In consequence, it lacks the gloss that it would have if the proportion of oil used were greater. It is the hardening of the vehicle in the surface of the film which produces the gloss.

A glossy surface is dirt-resisting and can be washed, being hard and smooth, compared with the flat-finished surface, which under the microscope will show the irregularities of the adjacent particles of pigment. A flat white, however, has the advantage that it does not yellow; it is the oil vehicle that yellows, and, as said heretofore, there is little of the vehicle in a surface that is finished flat.

More important than these facts as to washability and dirt resistance for the purpose of this study, however, are the light-reflecting qualities of the flat and glossy finishes. The light reflected from the former will be diffused owing to the microscopic irregularities of the surface. The glossy surface, however, being smooth, functions as a mirror and reflects the light without diffusion. The flat-finished surface acts as if it were composed of a multitude of reflectors set at varying angles to the direction of the light that falls upon them. The diffused light reflected is in consequence softer, and the shadows cast by objects in its path are less sharp in outline. If refinement of lighting effect were being sought, therefore, as would be the case in hospital and domestic interiors, the flat finish would be preferred. But for plant interiors, the slightly superior illuminating quality of the flat finish, as compared with that of gloss paint, is balanced by the superior dirt-resisting quality of the latter. Thus there is little choice between the two in practice in the field of application here considered.

One other quality of paint is of interest in connection with its use about mining and metallurgical plants, as indeed with any plant, and that is its durability. Whether paint be applied for illuminating, decorating, or protective purposes, we are interested in knowing how long the coat is going to last. Naturally, the composition of the paint is again the ruling factor. Again it is a question of the proper proportioning of oil and pigment.

(Continued on page 812)

Separation and Regeneration of Caustic Soda in the Harris Process of Lead Refining

By R. WINTER
Metallurgical Engineer, London

IN THE May 5 issue, Mr. Winter gave a general description of the Harris process and of the equipment and reagents used. Molten sodium salts, the nitrate, hydroxide, and chloride combine with impurities in the lead bullion, forming sodium arsenate, stannate, and antimonate. The spent reagents are then drawn off and treated for the recovery of their constituents, as will be described by Mr. Winter in the following article and in the next succeeding one, which will appear in an early issue.

The wet treatment of the spent reagent has for its object the regeneration of the alkali employed in the foregoing dry treatment and the recovery of associated material of value. The spent reagent contains sodium hydroxide, oxide, and chloride, together with any or all of the following: sodium arsenate; sodium stannate; sodium antimonate; a little sodium carbonate; and a few lead prills.

The practice adopted consists fundamentally of the separation of the metallic sodium salts by filtration or settlement from an aqueous solution of those first named, the concentration of which is chosen as the maximum which will insure the substantial insolubility of the metallic salts. The separated solution is then evaporated for the recovery of the fused caustic-salt reagent required for the dry metal treatment, while the filtered insoluble salts are subsequently treated for their metal contents, with the separation of the combined alkali in a comparatively weak solution, which is that used as the original solvent for the molten spent reagent. Hence the treatment depends upon the solubilities of the oxysalts of the spent reagent in caustic-salt solutions and in water, which are as follows:

(1) Sodium oxysalt of antimony is practically insoluble in both hot and cold solutions of caustic soda of a certain strength saturated with sodium chloride, and also in water containing sodium chloride.

(2) Sodium oxysalt of arsenic is soluble in such solutions when hot; but is insoluble in cold aqueous solutions of caustic soda over a wide range of concentrations. It is somewhat soluble in cold solutions of very high concentration. It is soluble in hot and cold water, its solubility being greater in the former than in the latter. In the presence of oxysalt of tin, an arseno-stannate compound containing roughly three times as much arsenic as tin is formed, which is insoluble in caustic soda solutions over a wide range of concentrations.

(3) Sodium oxysalt of tin is only slightly soluble in hot alkali solutions of high concentration and is insoluble in cold solutions. Solubility of sodium stannate increases rapidly with decreasing concentration of caustic soda. It is soluble in both hot and cold water, but more so in the latter than in the former.

For the reason that one very important factor in the cost of operation of the process is the quantity of water which must be evaporated to recover the alkali in molten form, dilution of solutions is kept down to a minimum consistent with obtaining a solution of such strength that arsenic and/or tin oxysalts will be insoluble in the cold. Sodium stannate reaches its point of maximum insolubility in solutions of caustic soda saturated with sodium chloride when about 400 grams of caustic soda per liter of solution is present. On the other hand, although sodium arsenate is somewhat soluble in this, it is completely insoluble in rather weaker solutions. In practice, therefore, a solution strength has been adopted which will give the best all-round results. Such a solution contains, when cold, 350 grams of sodium hydroxide and 85 grams of sodium chloride per liter, equivalent to 25.92 per cent of sodium hydroxide, 6.30 per cent sodium chloride, and 67.78 per cent water, and has a specific gravity of 1.35 (70 deg. Tw.).

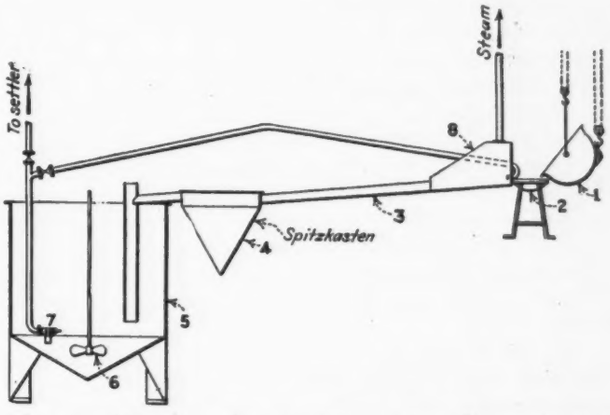


Fig. 1—Apparatus for treatment of molten saturated reagent in the Harris process

The spent reagent is converted into a slurry consisting of a suspension of insoluble sodium antimonate and stannate (if present), in a hot alkali-salt solution containing in dissolved form sodium arsenate and possibly a little stannate. This is effected by pouring the hot molten reagent into a rapidly circulating stream of water

or weak alkali. The operation is termed "granulating," on account of its analogy to a similar treatment of furnace slags.

The molten reagent is poured directly from the machine or through the medium of ladle 1 (see diagrammatic sketch Fig. 1, and the accompanying photograph Fig. 2) into a small dish 2 which serves to retain any molten lead. This dish is situated at the head of a

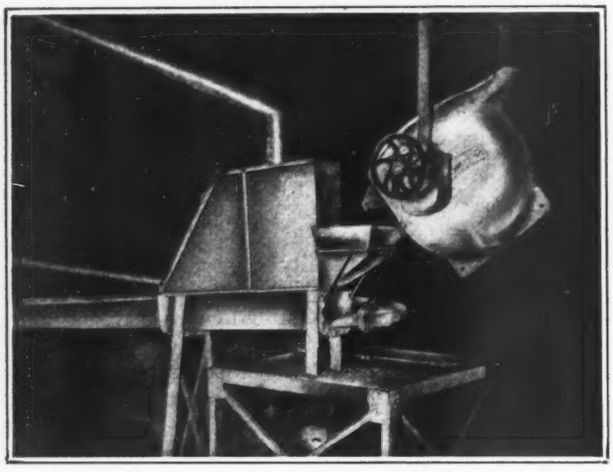


Fig. 2—Pouring molten sodium salts into a launder, previous to water treatment

launder 3, at one end of which is a lead separator 4 designed to throw out any small metallic prills which may be contained in the molten reagent. The sludge flows from the separator into a tank 5, which is filled with water or with solutions resulting from previous operations. It is provided with a stirrer 6 to prevent the settlement of heavy insoluble material and with a vertical pump 7 for circulating the liquor and sludge to the head of launder 3. The vertical pump having been set in motion, the water or liquor travels from tank 5 to the head of launder 3, where it meets the stream of molten reagent. The soluble constituents are immediately dissolved, attended by evolution of steam which is carried away by hood 8. Circulation is continued until the whole of the spent reagent is converted into a sludge. The lead prills collected in the separator are returned to the softening kettle.

The granulating tank 5 is designed to hold the slurry resulting from the granulation of several batches of spent reagent, so that, the tank being filled with water or weak liquors from previous operations, successive additions of spent molten reagent are granulated therein until the liquor is of the specified strength—that is to say, until a cooled and filtered sample will yield a filtrate of 1.35 specific gravity (70 deg. Tw.). By this means weak liquor is concentrated to the desired strength without preliminary evaporation.

Presence of Impurities Complicates Treatment

It is manifest that the treatment of the slurry must vary according to its composition; for slurry obtained from the working of silver-lead of average purity the operating steps are very few and of the greatest simplicity, whereas the treatment of that from mixed alloys must naturally entail a procedure that is considerably more comprehensive.

For the present purpose it will be sufficient to describe the practice which is adopted for the wet treatment of the spent reagent resulting from the two classes of impure metal most commonly encountered as embraced in the following divisions:

(1) *Silver-leads,* containing comparatively small quantities of arsenic and antimony, and no tin.

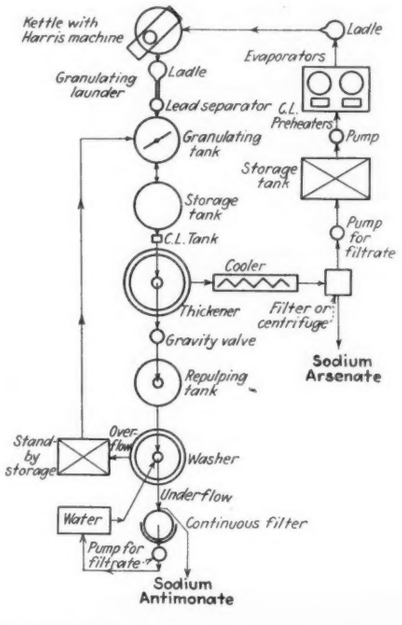
(2) *Secondary and residual leads and alloys,* high in arsenic, tin, and antimony.

(1) *Treatment of Material Resulting From the Operation of Silver-Lead Free From Tin*—As shown in Fig. 3, the hot, mildly agitated slurry containing the insoluble antimony oxysalt in suspension and the arsenic oxysalt in solution is pumped from the granulating tank through storage to a settling tank or Dorr thickener, which is kept above 70 deg. C. so as to retain in solution the arsenic which would otherwise crystallize and be thrown out. Insoluble sodium antimonate, if the scale of operations warrants, is washed in a counter-current washing machine of the Dorr type and filtered on a continuous-suction filter. The first, or strong wash water, is returned to the granulating tank. Treatment of the sodium antimonate for the production of metallic antimony or antimonial products is effected, as will be described further on.

The caustic solution overflowing from the Dorr thickener is cooled to about 25 deg. C., at which the whole of the sodium arsenate becomes insoluble and is separated as crystals of $Na_3AsO_4.12H_2O$ by filtration or centrifuging. Effluent from this operation will be a solution free of arsenic and antimony, containing 350 grams of sodium hydroxide and 85 grams of sodium chloride per liter. It is evaporated and fused in a flash type evaporator (described later), reproducing the reagent required for subsequent operations of softening the lead bullion or alloy.

The crystals of sodium arsenate may either be sold as such or may be treated for the recovery of the contained alkali and arsenic. In this latter case they are dissolved in hot water or wash waters, furnishing a solution containing Na_2HAsO_4, from which, on heating with freshly slaked lime, arsenic is precipitated as calcium arsenate

Fig. 3—Flow sheet showing treatment of sodium salts substantially free from tin



and caustic soda liberated. The solution strength is regulated so that the caustic soda solution regenerated will contain 10 per cent of free alkali, and this solution is subsequently used in the granulating tank as a solvent for fresh molten reagent. Consequently, as a general rule, the only solutions to be evaporated are those of uniform strength containing, as above mentioned, 350 grams of sodium hydroxide. Where, however, the original impure lead contains much arsenic, the quantity of caustic soda recovered, due to its regeneration from chemical combination with the arsenic and also to the dissociation of sodium nitrate, may furnish more alkali than can be absorbed in subsequent dry operations. This excess will be in the form of weak caustic soda solution and can be recovered if desired by any recognized method of evaporation. The same remarks apply to tin, although the excess recovery is not so pronounced, as the sodium hydroxide combined with tin in sodium stannate is only 0.674 times the weight of the tin, as against 1.6 times the weight in the case of arsenic. Usually, however, the weak caustic solution is returned to the granulating tank to make up for the loss of sodium hydroxide inherent to the removal from the circuit of the alkali in combination with the sodium antimonate, which in general is not recovered.

(2) *Treatment of Tinny Material*—In treating the spent salts from the softening of secondary or residual material high in tin, a different procedure must be adopted, owing to the fact that the sodium oxysalt of tin is only slightly soluble in a hot caustic soda solution containing 350 grams of sodium hydroxide and 85 grams of sodium chloride per liter, which in the process is adopted as standard. At 100 deg. C. such a solution will only dissolve sodium stannate equivalent to 6.1 grams of tin per liter, and if the quantity of tin in the spent reagent exceeds this amount, the excess must remain insoluble with the sodium antimonate.

As pointed out in the foregoing, if the quantity of antimony present in the lead be sufficiently great, the tin and arsenic can first be removed in the dry operations without substantially affecting the antimony, which is later removed and recovered in a particularly pure state. In the adoption of this practice, either sodium nitrate or impure sodium antimonate, the resulting product of previous operations, may be used as the oxidizer for the removal of the arsenic and tin, and the small quantity of impure sodium antimonate made can thus be taken care of. There would therefore be produced two distinct batches of spent reagent, which are treated quite separately:

(a) containing arsenic and tin with very little antimony,

(b) containing sodium antimonate but free of arsenic and tin.

(a) In treating the batch of spent molten reagent of the first category containing arsenic and tin and little antimony, the simplest method and that most usually adopted in practice is to granulate as before (see Fig. 4), maintaining the same solution strength, and to render the sodium arsenate and stannate substantially insoluble together with the sodium antimonate by cooling the slurry. The insolubles are then separated by filtration from the caustic-salt solution, which is evaporated. The filter cake is treated as later described.

In some works, where in particular the amount of arsenic is quite small, advantage is taken of the widely different solubilities of sodium arsenate and sodium stannate in alkali solutions of varying strengths. The spent molten reagent is dissolved in a quantity of water which will produce a solution containing about 200 grams of free sodium hydroxide per liter, which is capable, when either hot or cold, of keeping considerable sodium stannate in solution, but in which sodium arsenate is quite insoluble when cold. The insoluble sodium antimonate is settled out of the hot solution, collected as before, and utilized as oxidizer in subsequent dry operations. Hot solution containing both arsenic and tin is cooled. The sodium arsenate crystallizes out and is separated. Residual alkali solution carrying sodium stannate is evaporated until it reaches a strength of about

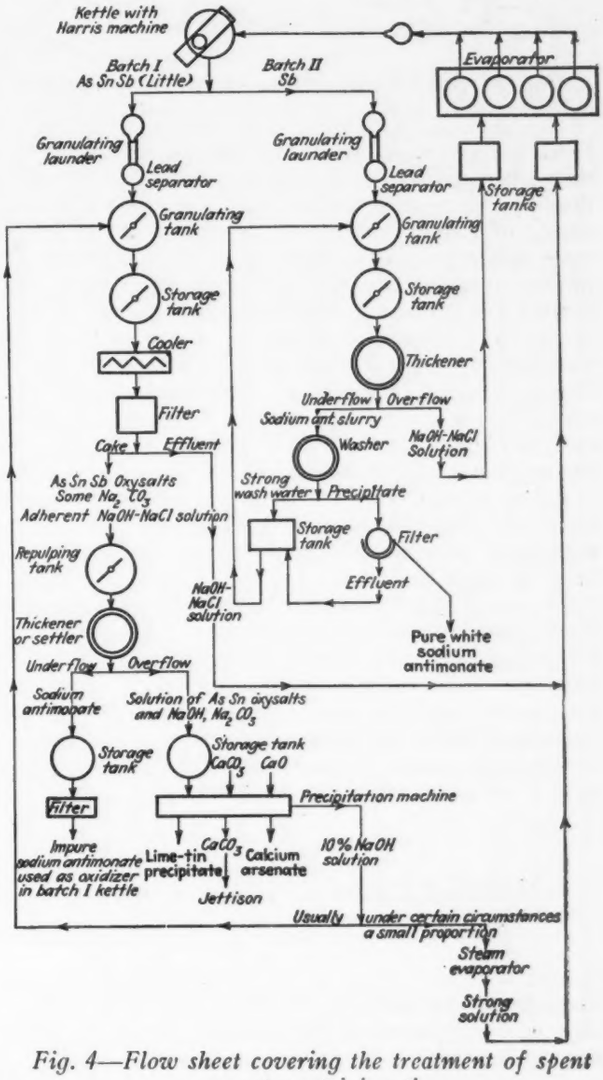


Fig. 4—Flow sheet covering the treatment of spent reagent containing tin

400 grams of free sodium hydroxide per liter, and the now precipitated crystals of sodium stannate are removed from the solution, which is further evaporated for the recovery of the alkali.

The method has disadvantages—first in that the evaporation of more water becomes necessary, and, second, because sodium arsenate always carries with it sodium stannate in the form of arseno-stannate compound. The practice should therefore be adopted only where the original quantity of arsenic is small, when the amount of tin crystallized out with arsenic becomes negligible.

(b) The batch of spent molten reagent in which the sole impurity is antimony is granulated, and the resulting slurry fed to a continuous thickener of the Dorr type (see Fig. 5). The overflow from this, consisting of caustic soda-salt solution of 1.35 specific gravity, is col-

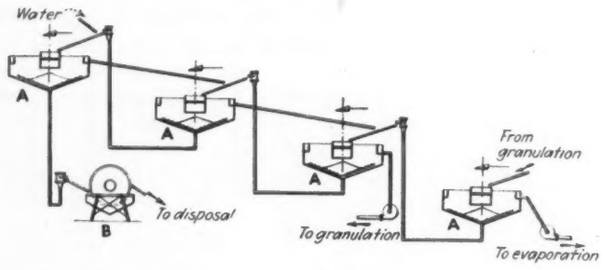


Fig. 5—Washing equipment for antimonial slurry

lected in the storage tank feeding the avaporator in which the molten reagent to be used in subsequent dry operations is regenerated as before. The underflow, consisting of sodium antimonate together with, of course, some adherent caustic solution, flows to a continuous washing machine *A*. The first or strongest wash water is used for dissolving subsequent batches of spent reagent. The precipitate washes very readily, and three washings are generally sufficient. Filtration on a continuous filter, *B*, presents no difficulties and the filter cake contains only 10 per cent of moisture. A typical analysis of such a cake dried at 100 deg. C. is: Sb, 48.5 per cent; As, nil; Sn, 0.010; Pb, 0.002; and Fe, 0.026.

It may be sold either for direct use by enamelers, converted into antimonial products, or reduced for the production of pure metallic antimony which can be marketed as such.

In general, the foregoing explains the manner in which the free caustic soda is separated out of the spent reagent and regenerated for further use. The arsenic and tin have been separated therefrom, as their crystalline oxysalts in the form of a wet alkaline filter cake, probably also containing some sodium antimonate. This cake may be treated in a variety of ways, as will be discussed in the next article, to appear in an early issue.

Rôle of Paint in Plant Lighting

(Continued from page 808)

A coat lasts as long as the oil that binds the pigment, inasmuch as destruction of the binder proceeds more rapidly than destruction of the pigment. When the binder decomposes, as it is sure to do in time from weathering and oxidation, the coat disintegrates. In a flat-finish paint the relatively large amount of pigment used serves to protect the binder against the destructive agency of the weather. On this account flat-finish paints are superior for outside use.

For interior purposes, with which this article concerns itself, weathering is of less importance as a destructive agency. Here the manner of applying the paint and the observance of proper precautions in allowing successive coats to dry are the factors which, in addition to the composition of the paint, determine its durability. Maximum durability will be obtained, according to Thompson (*Architectural Forum*, May, 1920) by proportioning the oil and pigment so as to give the greatest protection to the oil by the pigment, and also by allowing the maximum amount of time between the coats.

The Cost of Painting

What will painting cost? Several variable factors must be considered. Primarily, these are the costs of labor and of paint, the former being of chief importance. Here it should be borne in mind that it costs as much to paint with a cheap paint as with an expensive one. In general, the cost of paint is but one-quarter of the total cost of paint and labor.

The labor of painting may involve brushing by hand or painting by the more modern and more rapid way of spraying, or it may involve both. A manufacturer of spraying equipment estimates 500 sq.ft. per hour as the average spraying speed on large surfaces, smooth or rough. Average brushing speed on large smooth surfaces he estimates at 150 sq.ft. per hour. As for the area covered by a gallon of paint, his figure is 475 sq.ft. for the first coat, either by brushing or spraying, and 500 sq. ft. for the second. Another manufacturer estimates from 320 to 420 sq.ft. per gallon for different kinds of paint. Still another figures 600 sq.ft. to the gallon of white-lead paint. However, it depends largely on the painter.

Given the cost of paint per gallon and of labor per hour, the largest part of the total cost may be estimated. To this should be added the cost of erecting scaffolding and of protecting machinery and floors; also depreciation and overhead, if the estimator insists on accuracy. Where old paint surfaces must be removed before being repainted, the cost of such removal must, of course, be included.

Some Minor Uses of Paint

Painting of equipment in mining and metallurgical plants is resorted to at times, and, where a company's finances allow it, it is worthy of consideration. Such painting retards corrosion and decay, if the paint be properly selected. It also helps the lighting scheme, if distinctive colors be selected, and so aids in reducing the hazards of machinery, especially where the problem of securing adequate illumination is difficult. Another minor use for paint in plant interiors, one that aids the vision in tracing pipe lines and helps in other ways, is the practice of painting piping distinctively according to the character of the liquid or gas conveyed. This was discussed in *E. & M. J.* of March 3, 1928.

Credit for data and information made use of in preparing this short discussion of the rôle of paint in lighting plant interiors is due E. I. duPont de Nemours & Company, the National Lead Company, the New Jersey Zinc Sales Company, the U. S. Gutta Percha Paint Company, and the Aluminum Company of America. Those desiring to look further into the matter are referred to the following bulletins and papers on the subject:

"Cyclopedia of Paint Information," National Lead Company.

"Conflicting Paint Purposes," Gustave W. Thompson, *Architectural Forum*, May, 1920.

"Principles and Practices of Upkeep Painting," Chapter 21, E. I. duPont de Nemours & Company, Philadelphia.

"Increasing Factory Efficiency by the Proper Use of Paint," M. Rea Paul, Ninth Annual International Purchasing Agents' Convention, Boston, May 22, 1924.

"Aluminum Bronze Powder and Aluminum Paint," by Junius David Edwards. Chemical Catalog Company, publisher; 419 Fourth Ave., New York.

United Verde Extension Smelter

Part VI of "Revisiting Arizona Mining Camps"

By E. H. Robie
Associate Editor

FOUR miles or so southeast of Clarkdale, down the Verde River valley, lie the towns of Cottonwood and Clemenceau, near which is the smelter of the United Verde Extension Mining Company. This plant was built during the World War to smelt the ores from the company's Jerome mine, a few miles distant on the mountain side. The flow sheet of the plant, shown on the next page, is supplemented by a list of the more important equipment, which shows the varied kinds required in a smelter of this type, with its subsidiary machine, carpenter, and boiler shops. The 2,500-kw. turbo-generator mentioned has been installed within the last year or two, following the general tendency to substitute turbo for reciprocating units, and the Cottrell plant was installed last year. The Cottrell is of the squirrel-cage type and is used for treating the gas from the six 20-ft. 6-hearth Wedge roaster units, following preliminary settling in a dust chamber and balloon flue. Installed at a cost of about $40,000, it is expected that the investment will be returned in approximately a year, such is the improved clearance thereby obtained. The Cottrell plant is situated between the roaster dust chamber and the stack.

The six Wedge furnaces are forced to capacity when two reverberatories are running; they can handle about 150 tons per day each, roasting from 20 to 9 per cent sulphur. The remainder of the reverberatory charge is made up of unroasted ore, flux, and reverted material.

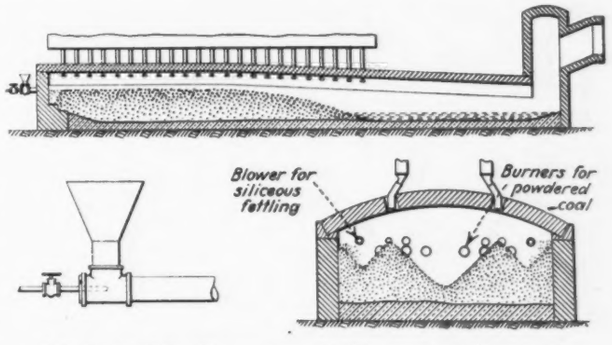
The two reverberatories are each 25x120 ft., inside dimensions, with a longitudinally sloping arched roof. Treating an all-hot charge, they are capable of smelting about 750 tons per day each, though their capacity is about 75 tons less than this when cold siliceous ore is added to the charge. At the time of my visit, about 450 tons of calcine per furnace was being smelted, plus about 50 tons of siliceous ore. The manner of feeding this was unique. To avoid infringement of the Carson patents for side-feeding, George W. Prince developed and patented the following scheme (U. S. Patent No. 1,650,907), which is further explained in the accompanying sketches. The charge hoppers have been moved back about 8 ft. from the side walls, so that there is approximately the same distance—8 ft.—between the two rows of charge hoppers as between them and the side walls. All the calcined material is charged in this manner, a drag conveyor carrying the charge as far as 60 ft. from the bridge wall. The siliceous ore is blown along the side walls by an arrangement similar to the Garr gun, as used on converters; this is mounted at the bridge wall on either side of the furnace, and the ore blown in by converter air. Not only does this arrangement avoid patent infringement, but it is said that it results in better smelting conditions than when the calcines and siliceous ore were fed together along the side walls, as was the former practice.

For several years the fuel ratio was about 16 per cent or about 320 lb. of coal (carrying about 13 per cent moisture) per ton of dry ore smelted, though last year the ratio was between 18 and 19 per cent, equal to 370 lb. per ton. The coal, which comes from Gallup, N. M., contains about 13 per cent ash, based on the dry weight, and has a heat value of 12,438 B.t.u. Last year, therefore, about 4,000,000 B.t.u. were required to smelt one ton of dry ore. About two tons of ash per day is taken from the flues, this ash assaying about 10 per cent of copper, or about 2 per cent higher than the ore charged.

Repairs are made to the reverberatory arch at intervals of from four to nine months. The roof is made of 20-in. silica brick, and silica brick are also used for the side walls.

Last year, 288,542 dry tons of new material (including lime rock) was charged to the roasters, assaying: Au, 0.035 oz.; Ag, 1.52 oz.; Cu, 7.27 per cent; SiO_2, 28.8; Al_2O_3, 2.9; Fe, 19.1; CaO, 7.8; S, 18.4. Practically all of this, of course, was subsequently smelted in the reverberatories, one of which was in operation for 300 days, and the other, 344 days. The slag averaged 0.2 per cent Cu; 40.1 SiO_2; 37.7 FeO; 13.3 CaO; and 6.9 Al_2O_3. The matte averaged 23 per cent.

Two of the three 12-ft. Great Falls type converters are kept hot, for a production of about 3,500,000 lb. of copper per month. This is cast into stationary molds,



Method of feeding ore and siliceous fettling to the U. V. X. reverberatory

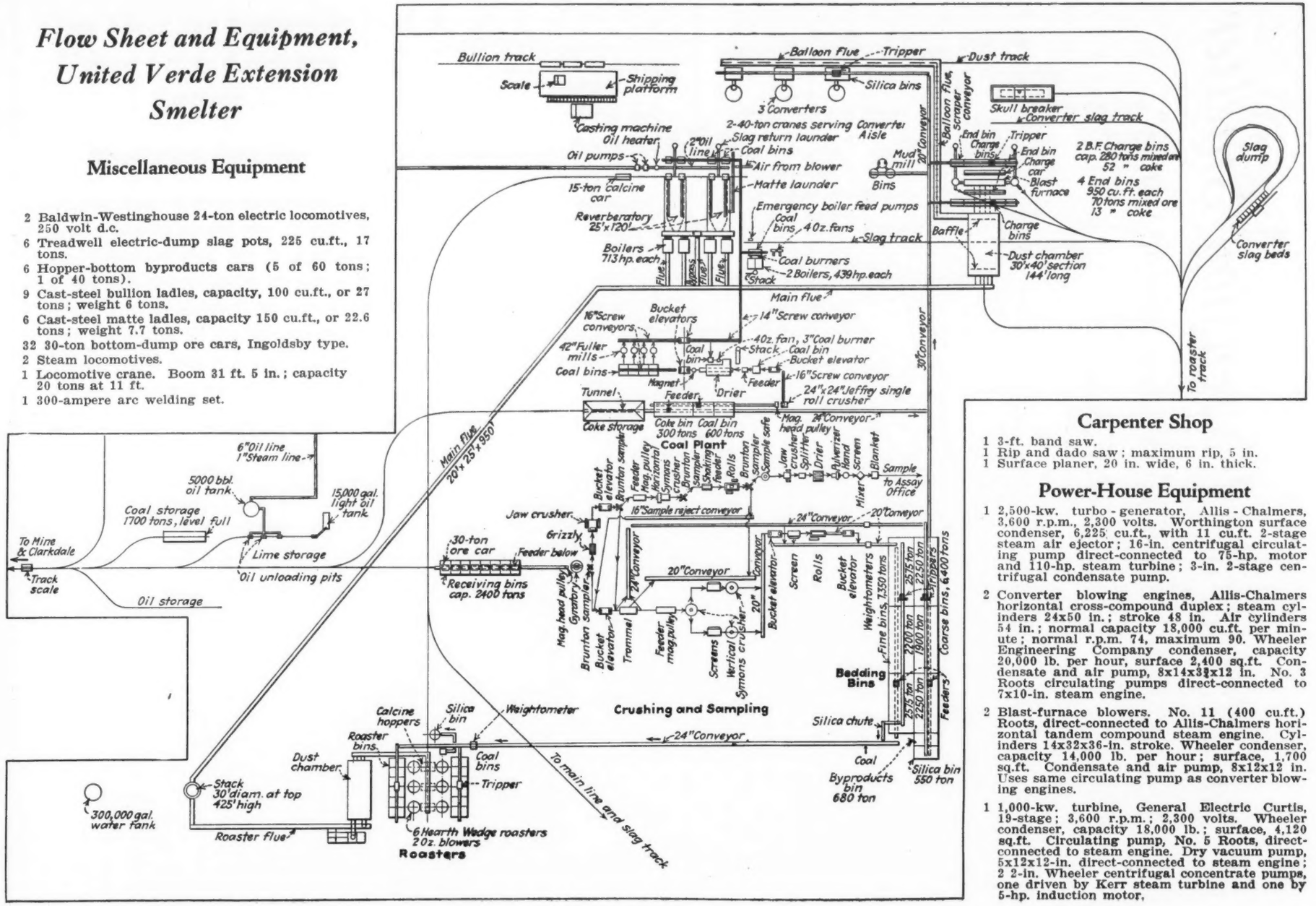
and shipped to the Nichols Copper Company, Laurel Hill, N. Y., for refining.

Smelting costs, according to the annual report of the company, amount to 2.5c. per pound of copper produced, which, on an 8.41 per cent ore, as it was last year, means about $4 a ton. Mining amounted to 2.67c. per pound; freight on ore, 0.1c. and freight on bullion, refining,

Flow Sheet and Equipment, United Verde Extension Smelter

Miscellaneous Equipment

2 Baldwin-Westinghouse 24-ton electric locomotives, 250 volt d.c.
6 Treadwell electric-dump slag pots, 225 cu.ft., 17 tons.
6 Hopper-bottom byproducts cars (5 of 60 tons; 1 of 40 tons).
9 Cast-steel bullion ladles, capacity, 100 cu.ft., or 27 tons; weight 6 tons.
6 Cast-steel matte ladles, capacity 150 cu.ft., or 22.6 tons; weight 7.7 tons.
32 30-ton bottom-dump ore cars, Ingoldsby type.
2 Steam locomotives.
1 Locomotive crane. Boom 31 ft. 5 in.; capacity 20 tons at 11 ft.
1 300-ampere arc welding set.



Carpenter Shop

1 3-ft. band saw.
1 Rip and dado saw; maximum rip, 5 in.
1 Surface planer, 20 in. wide, 6 in. thick.

Power-House Equipment

1 2,500-kw. turbo-generator, Allis-Chalmers, 3,600 r.p.m., 2,300 volts. Worthington surface condenser, 6,225 cu.ft., with 11 cu.ft. 2-stage steam air ejector; 16-in. centrifugal circulating pump direct-connected to 75-hp. motor and 110-hp. steam turbine; 3-in. 2-stage centrifugal condensate pump.

2 Converter blowing engines, Allis-Chalmers horizontal cross-compound duplex; steam cylinders 24x50 in.; stroke 48 in. Air cylinders 54 in.; normal capacity 18,000 cu.ft. per minute; normal r.p.m. 74, maximum 90. Wheeler Engineering Company condenser, capacity 20,000 lb. per hour, surface 2,400 sq.ft. Condensate and air pump, 8x14x36x12 in. No. 3 Roots circulating pumps direct-connected to 7x10-in. steam engine.

2 Blast-furnace blowers. No. 11 (400 cu.ft.) Roots, direct-connected to Allis-Chalmers horizontal tandem compound steam engine. Cylinders 14x32x36-in. stroke. Wheeler condenser, capacity 14,000 lb. per hour; surface, 1,700 sq.ft. Condensate and air pump, 8x12x12 in. Uses same circulating pump as converter blowing engines.

1 1,000-kw. turbine, General Electric Curtis, 19-stage; 3,600 r.p.m.; 2,300 volts. Wheeler condenser, capacity 18,000 lb.; surface, 4,120 sq.ft. Circulating pump, No. 5 Roots, direct-connected to steam engine. Dry vacuum pump, 5x12x12-in. direct-connected to steam engine; 2 2-in. Wheeler centrifugal concentrate pumps, one driven by Kerr steam turbine and one by 5-hp. induction motor.

Power-House Equipment (continued)

1 1,500-kw. turbine, Allis-Chalmers Parsons type, 3,600 r.p.m., 2,300 volts. Wheeler condenser, capacity 24,000 lb.; surface, 5,500 sq.ft. No. 5 Roots circulating pump direct-connected to 10x12-in. Ball engine; 2 2-in. Wheeler centrifugal condensate pumps direct-connected to Kerr turbine, and one to 5-hp. induction motor. Vacuum pump, 7x14x14 in., steam driven.

2 Westinghouse motor-generator sets, 200 kw., 250 volts, d.c.
1 Sullivan air compressor, 14x8½x10 in.; 500 cu.ft.; 75-hp. motor.
1 Ingersoll-Rand compressor, 15x9x12 in.; 500 cu.ft.; 75-hp. motor.
1 Sorge-Cochrane feed-water metering heater, 2,500 hp.
1 Sorge-Cochrane hot-process chemical purifier, 720 gal. per hour.
2 Worthington boiler feed pumps, 10x16x7½x10 in.
1 Aldrich triplex pump, 3½x4 in., for ice-plant water.
1 Exciter, 25 kw., 125 volts, 3,600 r.p.m.; turbo-generator; non-condensing.
1 Baker Iron Works 20-ton crane.
1 Ingersoll-Rand compressor, 19x12x16 in.; 900 cu.ft.; 150-hp. motor.

Machine Shop

1 20-in. Stockbridge shaper.
1 6-ft. American radial drill.
1 2-ft. Aurora upright drill.
1 14-in. x 8-ft. LeBlond engine lathe.
1 30-in. x 24-ft. lathe.
1 No. 5 Williams pipe machine, 3½ in. to 12 in.
1 No. 1½ Williams pipe machine, ½ to 3 in.
1 No. 4 Robertson power hacksaw.
1 20-in. Whitney water-tool grinder.
1 Cincinnati floor grinder.
1 2-in. National single-head bolt cutter.
1 Yankee drill grinder ¼ in. to 2¼ in.
1 30x30-in. x 10-ft. Cleveland open-side planer.
1 No. 10, 58-in., 150-ton hydraulic wheel press.
1 No. 3 Cincinnati milling machine.

Boiler Shop

1 Bement 1,100-lb. steam hammer.
1 30-in. vertical punch and shear.
1 6-ft. bending roll.
1 No. 4 American blower.
1 18-in. Ryerson steel saw.
1 Portable oxy-acetylene welding apparatus.
1 10-ft. pneumatic flanging clamp.

Cooling Ponds

Blast furnace: 69x119 ft., 8,223 sq.ft.; 32 ¾-in. Spraco nozzles.
Turbine: 110 ft. 2 in. x 160 ft., 17,627 sq.ft.; 72 ¾-in. Spraco nozzles.
Engine: 77 ft. 2 in. x 160 ft.; 12,347 sq.ft.; 48 ¾-in. Spraco nozzles.

Cottrell Plant

Gas volume: 65,000 cu.ft. per minute.
Treater consists of two units of two sections each. Each section has 12 ducts containing 8 discharge electrodes each. Total number of feet of discharge electrodes: 3,840.

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and selling, 1.81c., making the total cost of the copper produced by the company about 7¼c. per pound, exclusive of depreciation, depletion, and taxes, which of course, should fairly be considered.

In walking about the plant with George W. Prince, assistant general manager of the company, in charge of the smelter, I noticed a large volume of steam blowing away, apparently to waste. Inquiring about this, I was told that there was often a surplus of steam from the waste-heat boilers, more than sufficient to supply the mine and smelter with power, and that as the power plant was not tied in with the main power system that operates in that section of the state, the steam is merely allowed to go to waste. Of course, it is relatively small in amount, but the fact that this condition exists shows that it may not always be possible to credit a wasteheat boiler used in connection with a reverberatory furnace, with all the steam that it is capable of making. This is the reason why more modern boiler equipment is not installed at some of the smelters; at others, however, all the steam that can be made is in demand, and it pays to use more refinements in production.

Before leaving the plant I met George Kingdon, general manager of the company, and James S. Douglas, president. As Mr. and Mrs. Douglas were temporarily occupying their charming home at Jerome, adjacent to the mine, I was permitted to enjoy their hospitality until the next morning. Mr. Douglas, or "Jimmy," as he is known not only to his acquaintances but to most other people in Arizona also, has a habit of befriending the lonely wayfarer, even to picking up a lone stroller on the road, a practice that Mrs. Douglas and most other people think is more charitable than wise. However, it often has pleasant results. "I just ran into Parke Channing down the road a-ways," said Mr. Douglas, "and he will be up to dinner too. Our regular cook is sick, but I guess we can get some liver cooked." Suffice to say, the inner man was well taken care of in all respects.

Gathered around the fireplace after dinner, the talk turned to many things, though not including sealing wax, nor cabbages, nor kings. Mr. Channing told many reminiscences; I was glad to see that he was again in excellent health, and actively at work throughout Arizona securing information helpful to his brother, R. H. Channing, Jr., in equipping the Flin Flon, in Manitoba, for early production. I met him several times later—at Globe, Miami, and Ajo. Though Parke Channing is now making his home on the Coast, he continues a frequent visitor in the East; in fact, I learned from him of one of the best places to dine in New York, and what to order. He promised to give me a card to the doorman, but has not yet done so. Mr. Douglas told us of his admiration for France and the French, and Mrs. Douglas spoke of the resemblance between Arizona and certain parts of Egypt, the similarity making her homesick when traveling in that land.

Lack of an assured future supply of ore after the present ore reserves of the "Little Daisy" are exhausted seems to be occupying Mr. Douglas' mind these days. He did not paint any too rosy a picture of the prospect, though I am told that he is an habitual pessimist in these matters. About 960,000 tons of 8 per cent ore is developed, or only about four years' supply at the current rate of production. Those familiar with this deposit know of the bonanza of high-grade ore—averaging perhaps 12 per cent copper—that was found between the 1,300 and 1,650-ft. levels, covered with barren quartz. At the 1,400 level, this mass was about 250 by 450 ft. in extent. A separate and smaller orebody in which much of the current mining is being done bottoms at the 1,750 level, and another at the 1,900 level. No ore below this has yet been found, though sinking will be resumed in the hope of finding some. Work in other districts has been disappointing; in the ground adjacent to the Noranda, in Quebec, some high-grade ore was found exactly where it was expected to be, but unfortunately there was not much of it. "A chunk about the size of that table," said Mr. Douglas. The Bisbee Queen, under the direction of M. J. Elsing, whom I later met at Bisbee has a shaft down 800 ft., but the 4,000 ft. of drifting and crosscutting done last year was unproductive, and conditions do not seem particularly encouraging for an increase in the U. V. X. ore reserves in this quarter. However, I fancy that with the company's evident desire to find more ore either in Jerome or elsewhere, success will be attained.

Arizona's Famous Meteor Crater

ONE of the world's most interesting natural phenomena is the Meteor Crater near Flagstaff, Ariz. The latest developments in the search for this supposed body of nickeliferous iron, with associated precious metals, will be described by Mr. Robie next week.

Minor Metals and Non-Metallic Minerals of Montana

By J. P. Rowe

Professor of Geology, State University of Montana, Missoula, Mont.

MOST PEOPLE, thinking of Montana's mineral resources, include only copper, gold, and silver; and possibly, at present, lead and zinc. They forget the numerous other deposits of minerals of economic and potential importance, in the state, such as chromite, manganese, sapphires, graphite, and Iceland spar. To be sure, the value of the output of the minor minerals is comparatively small, but they may become a valuable asset to the mineral wealth of the state. A brief discussion of several of Montana's most important minor minerals will be given, including the following: antimony, asbestos, barite, chromite, corundum, including sapphires and rubies; diatomite, graphite, Iceland spar, manganese, mica, molybdenum, monazite, nickel, platinum, tungsten, zonolite, and iron ore.

ANTIMONY—Montana has one good deposit, so far as is now known, of stibnite, and that deposit is not far from Thompson Falls, Sanders County, in the extreme west of the state. Antimony is found associated with lead and other minerals elsewhere, but the deposit at Thompson Falls is the only known occurrence of stibnite in the state. It has been worked, but, at present, its production could not be shipped to the Eastern market with a profit and, hence, the property is idle.

Asbestos—This name embraces two different mineral species. There is a hornblende asbestos, sometimes called the long fiber, and a serpentine asbestos, sometimes called chrysotile, or the short-fibered asbestos. The latter kind is more common in Montana. In the Bear Tooth Mountains, south of Red Lodge, Carbon County, is a deposit that is claimed to be of commercial importance. The Montana-Idaho Asbestos Company, operating in Madison County near the Idaho boundary, reported having reached the production stage during the latter part of 1924. It is claimed that both long and short chrysotile fibers are available here. The serpentine asbestos of Montana has probably been formed from chrysolite, amphibole, or pyroxene, and is therefore, a secondary mineral.

Barite—This mineral as yet is not a commercial mineral in Montana, although at least two deposits give promise. One is in Pattee Canyon, Missoula County, not far from the city of Missoula, and the other one is up Rattlesnake Creek about 7 miles from the city of Missoula. I have found nodular barite in the upper Cretaceous clays of Wibaux County, but not in commercial quantities. The barite near Missoula is massive, white in color, quite pure, and associated with specular hematite.

CHROMITE—This mineral very much resembles magnetite and was unknown in Montana until the spring of 1918. During that year I visited a deposit near Contact, Sweetgrass County, and later the U. S. Geological Survey made a report, Bulletin 725-A, upon this and other deposits in the state. Most of the occurrences are in Sweetgrass, Stillwater, and Carbon counties. The deposits in Sweetgrass and Stillwater counties belong to the same continuous belt, running from a little west of Boulder River near Contact, east to East Boulder River in Stillwater County.

Three localities in this chromite belt have been more or less developed. Best known is that at the west end on Boulder River. The second locality is known as the Fry-Dillon claims. They follow the pyroxenite belt, in which the Boulder deposit was found, from a point near the head of Iron Creek to the West Fork of Stillwater River, a distance of 4 to 5 miles. The third developed deposit is known as the Benbow claims. These claims begin near the Stillwater-Little Rocky divide and extend eastward for 2 miles to the west slope of Fishtail Creek Valley. It is thought that the chromite deposits extend from Boulder River to the eastermost end of this property, if not farther.

THE estimate of 150,000 to 200,000 tons of high-grade ore approaching 35 per cent chromic oxide, between Boulder River and East Fork, is believed to be moderate. The Fry-Dillon claims are estimated as being able to produce 50,000 tons of high-grade ore; and the Benbow properties are thought to have 130,000 tons of high-grade ore. At present a company known as the "American Chrome Products Corporation" is being organized. This company has control of seven claims—the Benbow groups, measuring, in all, 10,500 ft. in length, with ore exposed for about 10,000 ft. This company estimates more than 1,000,000 tons of chrome ore above what is known as the Eclipse Tunnel at the 400 level. The tonnage below the 400 level is inestimable, but it is said that the formation indicates that the ore will be deep seated. It is thought that 375,000 tons of high-grade ore, running between 35 and 40 per cent of

chromic acid, is a low estimate for the belt as a whole. The above statement appears highly plausible when one knows that the basis of estimation is only 100 ft. in depth. There seems to be no reason why the vein should not continue for several hundred feet in depth. The foregoing estimate takes no account of the low-grade or concentrating ore, of which there is a large amount. These properties are 34, 43, and 36 miles, respectively, from a railroad. Little is being done with them at present, but some day they will be worked and the chromite utilized.

Another chromite deposit is situated 10 miles southwest of Red Lodge, between Rock Creek and the West Fork of Rock Creek. This deposit has not been carefully explored, but it is not thought to be as large as the one in Sweetgrass and Stillwater counties.

MANGANESE—Several manganese minerals exist in Montana. However, commercially valuable minerals are largely pyrolusite, psilomelane, manganite, braunite, wad, and the unoxidized ore, chiefly a dense aggregate of rhodochrosite, with more or less quartz and a little pyrite or other sulphides. Mining of the carbonate ores at Butte promises to be active during the current year, now that a treatment plant has been erected. And near Philipsburg more high-grade manganese is now being mined than in all the other states in the Union put together. Other deposits of manganese than at Philipsburg and Butte are known in Montana. However, little if any development work is now being done on them. Some of the other Montana deposits are as follows:

Castle District—Lodes in this district have been reported by C. H. Clapp, president of the state university, who says: "The lodes contain rather large amounts of jaspery material that carries more or less manganese and iron and a few ounces of silver per ton. The material analyzed 6 to 13 per cent of manganese. Weed and Pirsson also mention a body of manganese oxide ore at the Blackhawk mine near Castle.

Neihart—Manganese carbonate is stated as the most abundant of the gangue minerals accompanying the lead-silver-zinc ores at Neihart.

Manganese is also found at Wicks; 3 miles northwest of Anceney, Gallatin County; in Dry Georgia Gulch, east of Twin Bridges; a mile north of Bonita, Granite County; and at Wigwam and Cherry Creeks, about 4 miles west of Melrose.

Pardee states that the Philipsburg district contains a minimum reserve of 130,000 tons of manganese ore (high-grade) and a prospective additional reserve of 350,000 tons. Material containing less than 30 per cent manganese and suitable for concentration is estimated at 50,000 to 230,000 tons. The total amount of high-grade manganese ore, including the carbonate and oxide varieties, in Montana was estimated by Pardee as at least 250,000 tons. All estimations are conservative, and I would not be surprised if two to three times the foregoing amount were produced.

CORUNDUM AND GEM STONES—Some time ago it was stated by the U. S. Geological Survey that "To the west of the Appalachian Mountains there are but four states in which corundum is authentically known to occur—namely, Montana, Colorado, Idaho, and California. The only localities of any commercial importance are those in Montana." The corundum deposits in Montana are in the south central part of Gallatin County, and at one time two or three companies were developing the properties. The deposits are 23 miles south of Belgrade and 14 miles southwest of Bozeman. Not much has been done with these deposits for some time. Under the head of corundum, and having the same general composition, come the two gem stones, sapphires and rubies. Rich red rubies have been found in the gravels of the upper waters of Rock Creek, Granite County, and in less amount in the gravels of Cottonwood Creek, Powell County. Associated with the rubies in the gravels are other corundum gem stones, especially sapphires. The rubies form only a small percentage of the gems obtained.

Montana is probably the only state in the Union where systematic mining for gem sapphires has been undertaken. Practically the entire world's supply of sapphires comes from Siam, Australia, and Montana. Sapphires were first found in the state by miners, who were washing the gravels of the bars on the Missouri River, east of Helena, for gold. Actual mining was begun in 1891. Several bars were later worked near Canyon Ferry. Other deposits were then found, such as those at Yogo Gulch near Utica, Judith Basin County; Cottonwood Creek, Powell County; and Rock Creek, Granite County. The Yogo deposits are found in an igneous dike, and mining is done as if the ore were gold. This is the only place where sapphires are now being mined in Montana.

The sapphires in the Yogo district were first found in the gravels of the Yogo Fork of Judith River. In following these up the creek, their original source was located in dikes of basic igneous rocks, probably monchiquite, cutting Madison limestone. For many years two companies operated in this district, one an English and the other an American concern. However, recently the English syndicate, known at the New Mine Sapphire Syndicate, purchased the American company's holdings.

Most of the gem sapphires are blue. Many other colors are found, but, for the most part, these other colored stones are used in making jewels for watches or as abrasives.

Diatomite—This material is found in Montana in the Flint Creek Valley, not far from New Chicago, and also in the Missouri Valley near Townsend.

GRAPHITE—High-grade graphite is found in Montana near Dillon, on the ridge between Van Camp Creek and Timber Gulch, near the southwest end of the Ruby Range. It has been mined in a desultory fashion for a number of years. Although the deposits are not thought to be extremely large, the graphite for the most part is of an unusually high quality and pronounced by some to be equal to that extracted in Ceylon.

Iceland Spar—So far as I know, Montana is the only state in the Union, and, in fact is among the few places on earth, that has deposits of the optical Iceland spar. Here, it is found sparsely in Sweetgrass and Park counties. In fact, a series of veins of calcite material, containing some spar, runs from upper Deer Creek, Sweetgrass County, northwest as far as Wilsall, Park County. Very little is being done at present with this material, although there is considerable demand for the optical kind.

MICA—Good deposits of muscovite mica have been reported in this state. Many years ago a deposit, 8 miles southeast of Dillon, Beaverhead County, is said to have yielded plates 8¼ by 18¾ in., and some good muscovite has been found east of Dillon about 14 miles

in the edge of the Ruby Mountains. It is claimed that this deposit is large and capable of yielding large pieces. Another deposit has been reported in the Little Belt Mountains, near Barker, Cascade County. Other localities have been reported, but nothing authentic is known of them. Very little has been done in the way of developing the mica deposits, although a movement is on foot to work the deposits near Dillon.

Molybdenum—Several minerals contain this element, but the three that are found in Montana are molybdenite, wulfenite, and molybdite. The last is largely a decomposition product of the first. Molybdenite is found, possibly in commercial quantities, near Chico, Park County; north and west of Garnet, Granite County; and 14 miles east of Lo Lo hot springs on the north side of Lo Lo Creek, Missoula County. One or two other localities have been reported, but nothing is known concerning them. Wulfenite is found in some of the mines of the Radersburg district, Broadwater County, but has never been worked commercially.

MONAZITE—This mineral is a phosphate of cerium, lanthanum and didymium, usually with thorium oxide, and the commercial deposits are always placer. It is heavier than ordinary minerals and "hangs back" in a placer pan. Deposits occur in the black sand at Princeton, Granite County; near Norris, Madison County; and in most of the placer deposits of the extreme western part of the state. As yet no deposits have been worked commercially and, therefore, the extent of monazite in western Montana is not known.

Nickel—The mineral pyrrhotite, which is frequently nickeliferous, is found in Montana in only one locality, near the chromite deposit on the Boulder River in Sweetgrass County. Nothing much is known concerning the deposit, except that it contains nickel.

Platinum—So far as I know, Montana has never produced an ounce of platinum for commercial use, though it has been found in at least two localities in the state, The first place is near Contact, Sweetgrass County, and the second near Troy, Lincoln County.

Tungsten—To my knowledge, the only place that has produced commercial tungsten minerals in Montana is at Jardine, Park County, where they occur with gold. The mine has been closed down for two years or so.

Zonolite—This is not a natural mineral, but is a product resulting from heating phlogopite mica. Its occurrence and commercial development were described by E. N. Alley, manager of the Zonolite Company of Libby, Mont., in the *Engineering and Mining Journal-Press* for Nov. 21, 1925.

IRON ORE—Montana is not as yet a producer of much iron ore, though I know of three fairly large deposits in the state. One is located east of White Sulphur Springs, Meagher County, and has been slightly developed. The ore is magnetite. Another deposit or deposits, and by far the most promising, are known as the Running Wolf hematite deposits. These are in Cascade and Judith Basin counties on Running Wolf and Dry Wolf creeks, 12 miles southwest of Stanford, on the Great Northern Railway, and about 54 miles southeast of Great Falls. The other deposit is in the Blackfeet Indian Reservation in northwest Montana. Owing to the fact that the deposit is a highly titaniferous magnetite, nothing has been done toward its development.

In addition to the mineral deposits in Montana mentioned in the foregoing paragraphs, stream tin (cassiterite) and native lead are found in the gravels of the upper Bitter Root River. The former mineral is also found in the Mountain View and other mines at Butte. Mountains of good limestone for quicklime, fluxing, and other purposes are found in many localities in the western part of the state. At Daily Spur, in Beaverhead County, is a large and quite pure deposit of white-quartz friable sandstone, which is suitable for glass sand. At present a small amount of it is being used as a flux in the smelter at Anaconda. The Jardine Mining Company, formerly operating a gold and arsenic deposit near Jardine, southern Park County, has been one of the largest arsenic producers in the United States. Also, each year the Washoe smelter at Anaconda produces an enormous amount of arsenious oxide, from the copper arsenide ores of Butte. The large gypsum deposits in Montana should also be mentioned.

Emery and Magnesite from Greece in 1927

ACCORDING to the U. S. Department of Commerce, the emery mines of Naxos during 1927 produced 15,848 tons of emery, divided into 6,267 tons of first quality, 9,277 of second quality, and 304 of fragments. Exports totaled 14,651 tons, and local consumption took 280 tons. The exports included 4,276 tons for Great Britain, 3,070 for France, 2,945 for Germany, and smaller shipments to the United States, The Netherlands, Italy, and Spain. Nearly all of the consignments to the United States, and the larger part of those to the other countries, were of the second quality. On Jan. 1, 1928, the government lowered the prices of the extra- and first-quality emery in an effort to encourage purchases of these grades.

Business and Engineering

JUDGE EDWIN B. PARKER, at Washington recently, spoke of the profession of business. In a forthcoming issue, Prof. Donald H. McLaughlin, of the department of mining engineering, Harvard University, will outline the means being adopted at Cambridge, by cooperative effort with the Graduate School of Business Administration there, to enable the student to appreciate the significant aspects of new situations and to aid him in developing that business ability and judgment needed as essential adjuncts to technical skill.

Some mining engineers may refuse to subscribe to Judge Parker's classification of business among the professions; but much good will result if it is raised thereby in public service and public estimation. An attitude of ultra-professionalism in the mining industries will defeat its own ends, and mining engineers should realize that business aptitude is as essential to material success as technical knowledge and skill. The lack of a background of economics and business principles, as Professor McLaughlin maintains, is responsible for the relatively small number of mining engineers who are directing great enterprises, even those based on engineering operations.

COMMENT AND CRITICISM

When Meteorite Meets Earth

THE EDITOR:

Sir—I inclose an article on a remarkable Siberian meteorite, on the theory that it may not otherwise come to your attention. GRANT H. SMITH.

San Francisco, Calif.

The account, which is of unusual interest, is given herewith. It is taken from the April issue of the *Proceedings* of the Astronomical Society of the Pacific, being signed by N. T. Bobrovnikoff:

THE PODKAMENNAYA TUNGUSKA METEORITE

In a previous note I called attention to the remarkable meteorite which fell on June 30, 1908, in the province of Yenissei, Siberia. An expedition under L. A. Kulik was sent out by the Russian Academy of Sciences in February, 1927, with the definite purpose of locating this meteorite. A recent Bulletin of the Russian Academy of Sciences contains two articles by Mr. Kulik on the results of the expedition. As was mentioned before, the region of the fall is very inaccessible. It lies on the watershed between the rivers Podkamennaya Tunguska and Chuna, approximately half-way between the settlements Strelka and Vanovara. These are about 100 miles apart. Owing to the lack of geodetic points and to the unreliability of the maps, Kulik gives only approximate co-ordinates of the place: +61 deg. and 71 deg. east of Pulkova.

The place of the fall is a natural depression surrounded by hills. Before the fall it was covered by dense primeval forest. Now it is practically bare. The trees, stripped of branches and bark, lie in concentric circular rows with their tops pointed away from the center. They have marks of a uniform scorch, quite different from that resulting from an ordinary forest fire. The area of these scorched trees has a diameter of several tens of miles. The central part of this large area, several miles in diameter, partially bears marks of a peculiar pressure, which gathered it in furrows several yards deep and running in general northeast and southwest.

The whole central area is covered by dozens of recent funnels of different diameter, from several yards to tens of yards wide, and several yards deep. The funnels usually have steep banks, the bottom is of a swampy character and sometimes has traces of a central elevation. The moss bed in the southeast end of one part of the area is shifted away, giving place to a swamp; in the opposite side of the depression the moss is piled up as if the whole ground underwent a horizontal displacement toward the northwest. The expedition being a preliminary one, no attempt was made to excavate the meteorite.

Farmer Semenow, in settlement Vanovara, about 50 miles south from the place of the fall, saw in the north something like fire. He felt very hot and was afraid lest his clothes should catch fire. The flame disappeared instantly and it became suddenly dark. At the same time he heard an explosion and was hurled down several feet from the steps of his house where he was sitting, and lost consciousness. The air-wave worked havoc in his house, broke windows, displaced the floor, and even broke an iron bar in his shed.

Another farmer, Kosolapow, at the same place, felt as if his ears were singed. He asked the first farmer what was the matter, but at that moment he felt the air-wave, heard a sound like thunder, and saw the devastation of the house that followed.

Tunguse Luchetkan testified that a relative had stores and about 1,500 domestic reindeer at the place of the fall. All of these were destroyed. They could find only a few scorched carcasses of the animals; most of them were completely annihilated. All buildings were burned down and the utensils melted.

Many other people testified that the forest in the place of the fall was completely annihilated, although there was no forest fire in the usual sense of the word, and that there were many displacements of the ground. The intensity of the air-wave is well illustrated by the testimony of the railroad officials at Lalka, near Kansk, about 400 miles from the place of the fall. They felt the air-wave and heard a roaring sound. The engineer in charge stopped the train, being afraid of an earthquake. Some people saw at this place the meteor, about half as large as the moon, with a blue halo around it. The air-wave along the path of the meteor threw to the ground people and horses.

There are, of course, conflicting narratives, as is usual in such cases. It is clear, however, that we have to deal here with a phenomenon of exceptional intensity and interest. The heat wave accompanying the meteorite deserves special attention.

This is apparently the first authentic case of a meteorite doing harm to man and animals. Luckily it fell in a sparsely populated region.

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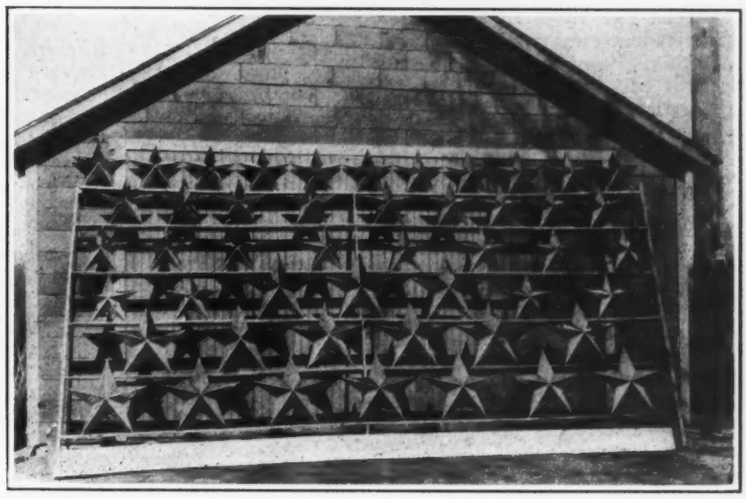
Stars for Louvain Clock

THE EDITOR:

Sir—The accompanying illustration shows the gold stars for the Louvain Library clock face. These have just been completed and shipped. I am sending you this because I think it may be of interest to the readers of *Engineering and Mining Journal*. H. J. STEHLI.

[In memory of engineers of the United States of America who lost their lives in the war, a clock and carillon are to be erected in the tower of the new library building at Louvain, Belgium. Popular subscriptions from engineers are to supply funds for the project. The necessary amount has not

The Aluminum-Bronze Clock Stars



yet been contributed, and subscriptions will be received by the Committee on War Memorial, 29 West 39th St., New York. The excess of obligations over contributions at present is $21,000. Thus far only about 3½ per cent of the 75,000 engineers who are eligible to contribute have done so. The committee is particularly anxious that a large number of the members of the American engineering societies shall be contributors to this international memorial to their fellow members whose lives were lost in the war, and accordingly small subscriptions are welcome.

The stars shown in the illustration are to be used in place of numerals on the face of the clock. They are made of a special alloy closely resembling gold in appearance, and composed of 92 per cent copper and 8 per cent aluminum. The alloy was selected by the American Brass Company as being most suitable. —EDITOR.]

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Mr. Hoover and Self-Advertising

THE EDITOR:

Sir—I was amused to see the criticism of Mr. Hoover written by Dr. Royal J. Jarvis, of Mexico. Dr. Jarvis thinks that there are ten thousand other engineers as well equipped as Mr. Hoover to be president and that some of these are probably "infinitely superior" to Mr. Hoover. I should be interested to see a list of the engineers whom Dr. Jarvis considers "infinitely superior" to Mr. Hoover as a Presidential candidate. The country should know about them.

There is one item in which I agree with Dr. Jarvis. He says boldly that Mr. Hoover's address "The Engineer's Contribution to Modern Life" is not entitled to a passing mark and was unworthy of a man of Mr. Hoover's alleged ability. As a teacher of English to engineering students I heartily agree with this criticism. Mr. Hoover in this address did what the typical engineer usually does when opportunity comes to him to say something interesting and inspiring for the public prints. He put his worst foot forward. The address, like those of many engineering students, was inept, weak, and disappointing. From my experience as engineering editor and as teacher, I find that engineers are at their best when describing a technical device or process; but that when, like Mr. Hoover on the occasion mentioned, they talk about their personal experiences they disappoint their friends. Perhaps it is due to modesty. Possibly it is due to the forced, impersonal style of English in which many engineers have been taught to express their ideas. Whatever the reason, engineers as a class do not speak for themselves as capably as other professional men such as lawyers and physicians. Dr. Jarvis can scarcely be consistent in calling Mr. Hoover a self-advertiser in the next paragraph after denouncing his address as unworthy of a schoolboy, for men skilled in self-advertising do not put their worst foot forward as Mr. Hoover did on this occasion. Nevertheless, when Mr. Hoover speaks or writes on impersonal subjects, he usually has something to say and says it well.

P. B. MCDONALD.
New York University.

* * *

Fundamental Factors Underlying Electrical Prospecting

THE EDITOR:

Sir—I was pleased to read in your issue of April 7, the letter of criticism from Mr. Karl Sundberg, of the Swedish-American Prospecting Corporation, in regard to my article, "Fundamental Factors Underlying Electrical Prospecting," which was published in your issues of Feb. 11 and 18. Mr. Sundberg's comments are of special interest to me for a number of reasons and I will discuss all points contained in his letter, in the order in which they were written.

The first paragraph is of a general nature in which Mr. Sundberg outlines the various points he discusses. The second paragraph states, "*. . . Serious difficulties encountered because of the comparatively high frequency used, such as the 'distortion of the primary field' due to surface influence causing 'distortion of wavefront' and 'phantom dips.'*" The original article particularly stresses the errors which may occur due to wave distortion and shows that they must be corrected for. Wave distortion is a complex effect and varies with the electrical characteristics of the media and the frequency of the wave. The effects of frequency, however, are not as serious as may be thought at first glance after due consideration is given the various theoretical and practical relationships.

Mr. Sundberg says, "*The fact that the frequency is varied from point to point . . . making it difficult to correlate results.*" It can be stated here that for any given traverse the frequency of the energizer is kept constant. However, there is no reason for errors resulting from using different frequencies at different traverses, since the traverses are independent of one another. As stated in the original article, the frequency at different traverses is changed to take care of the correction factors necessary in the particular region being studied. Since the wave velocity in a conducting medium varies roughly as the square root of the frequency, the displacement due to a change in frequency would be well within the experimental error, inasmuch as the frequency need be varied only a small amount to satify the operating conditions necessary for proper phase conditions.[1]

Quoting again from Mr. Sundberg's letter, "*The result, then* (of using high frequencies), *is to increase that part of the secondary field due to currents in the overburden (except in desert countries where the overburden is highly resistent), thus masking the field from any orebody which may be present.*" In so far as the values of the secondary fields due to the overburden and orebody are concerned, two things are of paramount importance: first, the relative conductivities of the orebody and the overburden; second, the directional characteristics of the two fields. The fact that there must be an appreciable difference between the conductivities of the ore and overburden is particularly stressed on page 238 of the issue of Feb. 11 in the original article.

Fig. 1 of the original paper illustrates the action of disseminated ores when subjected to a high-frequency field. Even in the case of a broken ore the impedance decrease due to the use of a high frequency is quite appreciable. Suppose the ore is distributed in the manner shown in Fig. 1. The impedance of this system of conductors and effective capacities may be represented by an equivalent series parallel circuit of pure resistance and capacities. The impedance of such an equivalent circuit is given by:

$$Z = \frac{R}{\sqrt{1 + R^2 4\pi^2 f^2 C^2}}$$

which at high frequencies approaches:

$$\frac{1}{2\pi f C}$$

Thus an increase in the frequency corresponds to a decrease in the impedance of the whole system. (Note: The equation given in the original paper is for a straight series circuit.) The increased current flow due to lowered impedance will result in a correspondingly larger secondary field from the orebody. The use of a higher frequency means that the *field intensity* at the surface of the ore after the wave has passed through the overburden is somewhat less than if a lower frequency had been used, but since the voltage induced varies directly as the frequency, the net result in the use of high frequencies is that a much greater current will flow in the type of orebody shown in the figure. In the case of an orebody having *no breaks* or lines of fracture, and being a perfect electrical conductor, there would, as stated in the paper, be no electrical advantage in going to higher frequencies. The advantage of moderately high frequencies would lie, however, in greater portability of equipment, with a resultant faster conduct of both the reconnaissance and detailed work. However, at this point the question of relative conductivities and directional effects comes in. In desert countries the highly resistant nature of the overburden makes the secondary field from the induced current flowing in the overburden negligible. Even in wet regions where the ratio of conductivity of ore to

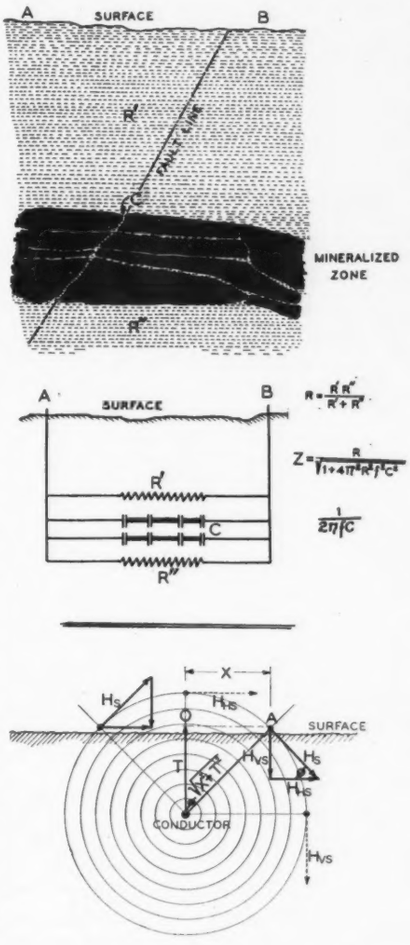
[1]Steinmetz: "Transient Electric Phenomena and Oscillations," pp. 372, 3d Ed. Jeans: "Electricity and Magnetism," p. 544, 4th Ed.

overburden may be only of the order of 100 to 1, the secondary field of the overburden will not mask that of the ore, because of the large difference in conductivities. The currents flowing in the orebody are so large compared to those in the overburden that the field due to the latter cannot mask that due to the former. In connection with the subject of overburden, Mr. Sundberg has apparently neglected a most important point. It will readily be apparent that the field caused by the current in the orebody will have a definite or well-defined axis, whereas that from currents in the overburden will not have such an axis. The result is definite indications of maxima and minima on the proper type of direction-finding apparatus for the orebody field and no such indications for the overburden field.

The present high and low operating frequencies used by the Radiore Company have been chosen as a result of considerable laboratory research and field work during a period of more that three years. In our experience we have never yet encountered a case such as Mr. Sundberg relates in which response actually becomes progressively poorer at frequencies above 2,000 cycles. We should be much interested in publication of complete detailed data regarding these experiments, including, of course, the conductivities of the various surface and underground strata and the mineralized zones; the type and nature of the mineralization—its size and extent, etc., together with the geological and tectonic conditions, a knowledge of all of which is essential to reasonable interpretation of such results.

Mr. Sundberg apparently assumes that the process must function best in the simple and ideal case. We have no disagreement with his equation (*IIa*) in which he concludes that, due to the effect of the primary field, the indicated location is below the true location by an amount equal to Ta, where T is the true depth and a the ratio of the horizontal components of the primary field to the maximum secondary field. In the simple case this is true, but in the practical case we have a compensating effect which comes from the distortion of the secondary field. This distortion, as is shown by Fig. 7 of the original paper, tends to indicate that the ore is above its true location, and thus partly offsets the first error. The equation (*IIa*) of Mr. Sundberg's was not mentioned in the original paper, but its effect is well shown graphically in Fig. 13 of my paper. In the simple case an orebody of small cross-section was assumed, but in practice this is more often not the case. Quoting from page 298 of the original paper, "It must also be recalled that the electrical axis of a conductor usually lies within the body. If the orebody possesses a fair cross-section, a considerable error in the indicated depth will still allow the orebody to be found when an approximate depth indicated by the correction curve is reached.

Mr. Sundberg's mathematics is of interest, and we are also pleased to discuss that part of his letter in more detail. In his mathematical analysis of the ideal case of a long, small diameter conductor parallel to the surface of the ground, the following points should be considered. In treating the special case in which the primary field



has no vertical component he obtains the result that the indicated depth of the electrical axis will be at different distances below the surface of the ground, depending on the ratio of primary to secondary fields, i.e., $Y = T\ (1 + a)$, where Y is the depth of the electrical axis, T the depth of the conductor, and a is the ratio of primary to maximum secondary fields. This variation of depth of electrical axis with variation in field ratio is well known, as can be seen by referring to my publication of Feb. 18. Fig. 13 of this paper gives experimental curves for different field ratios. As stated on page 298 of the same issue, the shifting in depth of the electrical axis is provided for by "proper distance of operation between the energizing and direction-finding apparatus." Although in theory the indicated electrical axis is below the conductor, in practice the axis is within the conductor, due to the compensating action of field distortion, and the thickness of the conductor.

Next we may consider Mr. Sundberg's Fig. 4, but first we should point out that, though interesting, the objections offered by the conditions of this figure are unimportant, as in the Radiore process the energizer is never placed in such a position relative to the orebody during detailed surveys as indicated by Mr. Sundberg's figure. It is only in the reconnaissance survey, where a preliminary idea of the layout of the conductors is being obtained, that such a condition could even temporarily exist. Granting, however, the conditions of his figure, for the sake of discussion, we still do not find it possible to agree with his conclusions.

From the mathematical point of view this arrangement is instructive. The quadratic equation which results gives two positions for the horizontal coordinate of the conductor. The solutions given by Mr. Sundberg are:

$$X_o = \frac{-T}{2b}\left(1 \mp \sqrt{1 - 4b^2}\right) \quad \text{(A)}$$

where b is the ratio of primary vertical field to maximum secondary field. We believe, however, that the *correct* equation is:

$$X_o = \frac{-T}{b}\left(1 - \sqrt{1 - b^2}\right) \quad \text{(B)}$$

$$X_o' = \frac{-T}{b}\left(1 + \sqrt{1 - b^2}\right) \quad \text{(C)}$$

since the maximum value of the secondary vertical field is proportional to $\frac{1}{2T}$, as can be seen by referring to Fig. 2.

Total intensity at A is H_s, which is perpendicular to both OA and the conductor.

Let H_{hs} = horizontal component of secondary field

H_{vs} = vertical component of secondary field

$$H_{hs} = H_s \cos \phi = H_s \frac{T}{\sqrt{X^2 + T^2}}$$

$$H_{vs} = H_s \sin \phi = H_s \frac{X}{\sqrt{X^2 + T^2}}$$

Since $H_s = \dfrac{2I}{\sqrt{X^2 + T^2}}$

where I is the current

$$\therefore H_{hs} = 2I \frac{T}{X^2 + T^2} \quad H_{vs} = 2I \frac{X}{X^2 + T^2}$$

Maximum value of H_{hs} is obviously $\frac{2I}{T}$.

For maximum value of H_{vs} with respect to X, we set $\dfrac{dH_{vs}}{dX} = 0$ and solve for X.

Solving this equation we get $X = \pm T$.

Introducing this in the equation for the vertical component we find:

$$H_{vs}\ \max = 2I \frac{X}{X^2 + T^2} = 2I \frac{T}{2T^2} = 2I \frac{1}{2T}$$

If now we introduce the primary

field our equations become on an arbitrary scale:

$$V' = \frac{X}{X^2 + T^2} + \frac{b}{2T}$$

$$H' = \frac{T}{X^2 + T^2} + \frac{a}{T}$$

Now, if we carry out Mr. Sundberg's operation, the factor 2 cancels out in the special case for $b = 0$ and we get $y = T(1 + a)$, which is his equation (*IIa*). However, in the quadratic equation the factor 2 does not cancel out and we get real solutions up to $b = 1$, and not only up to $b = 0.5$ as is the case if we omit this factor. Quoting from Mr. Sundberg's letter, *"The presence of the 'imaginary axis,' or, in other words, indications corresponding to no conductors but due only to an incomplete procedure, seems very serious."* There is, however, no "imaginary axis." The laws of simple algebra require that in solving a quadratic equation the various answers obtained must be tried to see which satisfy the original equation and *particularly* its boundary conditions. In this case it will readily be seen that one of the solutions is extraneous and does not apply to the actual case, since it does not satisfy the boundary condition for a zero primary vertical field; i.e., when $b = 0$. When the primary vertical field is zero and the direction-finding coil is vertical we may substitute $b = 0$ in the root equations (B) and (C). From (B) we get $X_o = 0$, and $X_o' = \infty$. When the direction-finding coil is vertical it follows from both theory and practice that the conductor must be directly below the coil; obviously, the conductor cannot be both "here" and at an infinite distance at the same time. From these considerations it follows that equation (C) is the extraneous root and therefore may be discarded.

Solving equation (B) for the same values as used by Mr. Sundberg, we obtain:

Ratio b	Value of X_o
0	0
0.1	$-0.05T$
0.2	$-0.10T$
0.3	$-0.15T$
0.4	$-0.21T$
0.5	$-0.27T$
1.0	$-1.00T$

from which it will be seen that the resulting errors are not nearly as serious as predicted by him. If we introduce the condition that the secondary primary field is also a maximum for $X = -T$, we get an identical set of solutions with opposite sign. This is to be expected since the secondary field is symmetrical about the conductor. He also states that in the case of a value of b larger than 0.5, *"The presence of the conductors thus is not revealed by this process."* This statement is continually being disproven by field work where conductors are being located in spite of the presence of a strong primary field. As pointed out in my paper, however, a proper ratio of *distance between energizer and direction-finding coil and depth is maintained.*

The purpose of the original paper was to point out in a general and elementary way the main factors which enter into the interpretation of the results from an electrical survey. No process containing as many unknown and variable quantities as does electrical prospecting is amenable to exact mathematical treatment. Whatever the apparent results indicated by such mathematics as we may be able to apply, the actual results over a period of several years have proven the process usually gives indications within ordinary mining tolerances. Actual operating conditions, at best, are complex and introduce errors which cannot be ascertained without the expenditure of more money than would usually be justified for the information to be derived from the survey. This condition is not peculiar to the inductive methods, but applies equally as well to all electrical methods of prospecting.

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Consultation

Black Cyanide and Reprecipitation

"What is black cyanide? Is reprecipitation of gold greater with this particular type of cyanide than with the ordinary commercial brand?"

Black cyanide, or Aero-brand cyanide, as it is commonly termed, is prepared in an electric furnace with calcium cyanamid and sodium chloride. Being a melt, or rather a solid resulting from a fusion, one cannot state definitely whether or not its components are sodium chloride and calcium cyanide, sodium cyanide and calcium cyanide, or a mixture of all three. Its precise composition is immaterial from the efficiency standpoint. Suffice to say that it contains the cyanogen radicle required for the dissolution of the precious metals.

No possible danger of reprecipitation of gold by reason of the use of this particular brand of cyanide may be anticipated. The whole subject of the so-called charcoal precipitation of gold has been obfuscated by the publication of the results of an elaborate research, undertaken to prove that the accepted theory—that an auro-cyanide was adsorbed as such—was untenable, and that the aurocyanide formed during dissolution was first converted into calcium aurocyanide.

As a matter of fact, a normal working cyanide solution is of highly complicated composition, probably containing the cyanide radicle in many forms; it is entirely different from a prepared laboratory solution. Moreover, an increasing proportion of the cyanide used today is the so-called black cyanide, in which the solvent may be largely in the form of calcium cyanide. No good can come of any theoretical investigation with laboratory solutions in an attempt to controvert or lessen the economic importance of the theory as originally advanced. This theory emphasized the vast importance of surface-tension influences in the action of an aurocyanide in contact with carbon; and the acceptance of the theory automatically led to the abandonment of the theory that the action was due to occluded carbon monoxide gas and the formation of a carbonyl aurocyanide or other analogous compound. The original substitute theory—that the gold was adsorbed, probably as the aurocyanide—suggested fine grinding if the carbon was to be used as a "precipitant"; and results proved the soundness of the logic on which it was based. Conversely, if the carbon was a contaminant of the ore, fine grinding should be avoided and provision made to allow the carbon particles to adsorb a coating of a worthless substance, such as oil, before being brought into contact with a valuable metal in solution.

* * *

American Engineers and the Belgian Congo

"What arrangements must be made by an American engineer who wishes to enter the Belgian Congo? To what extent will the Belgian government acknowledge mineral discoveries made therein?"

According to the Belgian Consulate in New York, the following formalities must be complied with by one who wishes to travel in the Belgian Congo:

1. He must possess an American passport with visa by the Belgian Consul, New York. The fee for such visa is $11.25 for a stay of less than three months and $20.25 for a stay of more than three months.

2. He must carry a medical certificate stating that he is free from any contagious diseases. This certificate must be legalized by the Belgian Consul. The fee for it is $2.25.

3. He must carry a certificate as to his good moral character. This certificate also must be legalized by the Belgian Consul, the fee for this being $2.25.

4. If the engineer in question is not employed by a firm at a regular salary, he must be able to deposit a security ranging from 2,500 to 5,000 francs.

With reference to the second part of the question, the Belgian Consul in New York states that information as to the extent to which the Belgian government will acknowledge mineral discoveries made in the Congo should be obtained directly from the "Ministère des Colonies" at Brussels, Belgium, or from the United States Consul at Brussels.

INDUSTRIAL PROGRESS

The World's Largest Excavator

THE new 15-cu.yd. electric shovel now being built by the Marion Steam Shovel Company was referred to briefly in the Annual Review Number (Jan. 21, 1928) of "Engineering and Mining Journal," on page 139. More details were given in the issue of March 24. A project such as this, which is truly sensational in the scope of its conception, merits further attention, however. Readers will find the following brief description of interest. It is contributed by M. H. Sheldon, of the Industrial Control Engineering Department of the General Electric Company, which has furnished the motors and control apparatus for the shovel:

Modern excavating constantly requires larger and heavier equipment. In open-pit coal mines, in iron and copper mines, in stripping overburden and loading ore; in limestone quarries, clay plants, gravel pits and reclamation jobs—in big construction projects of every type—the large electric shovels are daily demonstrating their economy and efficiency. They replace smaller shovels, doing the same work in less time and at an appreciable saving in labor and other costs.

A 15-cu.yd. electric power shovel, full revolving type, the largest shovel (in respect to dipper capacity, physical size, and weight) designed to date, is being built by the Marion Steam Shovel Company for the United Electric Coal Company, of Danville, Ill., for use in its open-pit coal mines. General Electric motors and control apparatus will be used throughout, the control being of the Ward Leonard type whereby the motor speeds are controlled by adjusting the voltage of the corresponding generators. All operations will be controlled by one operator.

It may be of interest to note a comparison between the working range of this shovel and the 8-cu.yd. shovel, which heretofore has been the largest shovel built by the shovel manufacturers. The data follow:

	15 Cu.Yd.	8 Cu.Yd.
Weight, tons	1,350	455
Boom length, feet	120	90
Dipper handle, feet	82	56
Working radius, feet	150	97
Loading height, feet	100	67
Stripping depth, feet	60	40

Power supply to the shovel will be alternating current at 4,000 volts. A five-unit motor-generator set, consisting of a synchronous motor rated 1,700 kva., 4,000 volt, 60 cycle, driving direct-current generators for hoist, swing, and crowd motions, and a 50-kw. exciter for supplying generator and motor field excitation, is the largest and most important part of the electrical equipment. The hoist generator is rated at 860 kw. 500 volt. The swing and crowd generators are each rated at 350 kw. 700 volt. All units will be mounted on a common base. Total weight of the motor-generator set will be approximately 130,000 lb.

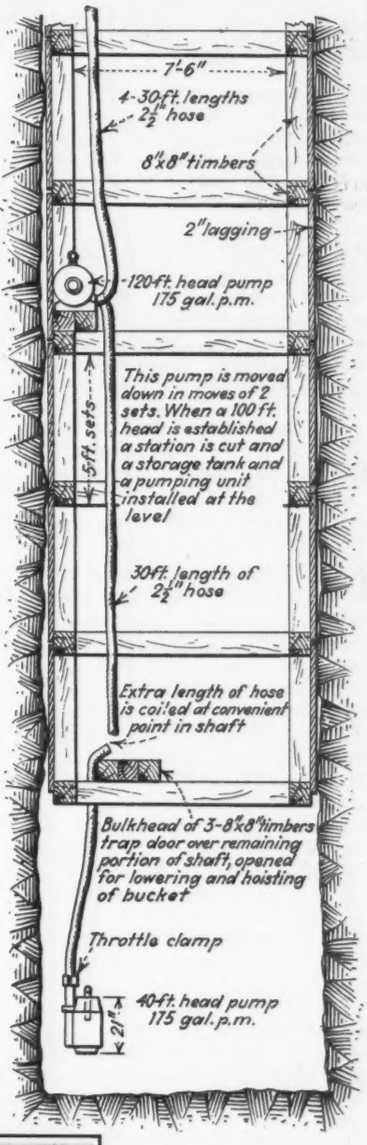
The hoist-swing-crowd motors will be shunt-wound, 230 volts, with roller bearings. Blowers will be furnished for each of these motors. The two hoist motors are 450 hp. each; the two swing and the two crowd motors are 175 hp. each.

Hoist and crowd motions will be controlled from drum switches with vertical handles, and, for the swing motion, a drum switch which will operate from a combination of foot pedals will be supplied. An auxiliary latch and contact device on the hoist drum switch will control the electric dipper trip for emptying the bucket at the proper time.

It is expected that the shovel will be placed in service about Oct. 1, 1928.

An "Electric Sponge" Devised for Shaft Sinking

THE problem of pumping water out of a shaft during sinking operations has always been a troublesome one, and any improvement in handling water under such conditions is to be welcomed. A new method has been evolved by the combined efforts of the engineers of the Park Utah Consolidated Mines Company and the Byron Jackson Pump Manufacturing Company. It comprises the employment of a compact horizontal


7'-6"
4-30-ft. lengths 2½" hose
8"x8" timbers
2" lagging
120-ft. head pump 175 gal. p.m.
This pump is moved down in moves of 2 sets. When a 100 ft. head is established a station is cut and a storage tank and a pumping unit installed at the level
5-ft. sets
30-ft. length of 2½" hose
Extra length of hose is coiled at convenient point in shaft
Bulkhead of 3-8"x8" timbers trap door over remaining portion of shaft, opened for lowering and hoisting of bucket
Throttle clamp
40-ft. head pump 175 gal. p.m.
2'-1"

Diagrammatic sketch of section of sub-shaft at Park Utah mine, showing method of using new type of electric sinking pumps

Two views of the "electric sponge" pump, which handles 175 g.p.m. under 40-ft. head

Horizontal centrifugal pump handling 175 g.p.m. under 120-ft. head

centrifugal pump furnished with 30 ft. of suction hose, at the lower end of which is a small vertical single-impeller pump, designed so that it can sit directly in the muck pile at the bottom of the shaft.

This "baby" vertical pump is of surprisingly small size and weight, being 12¾ in. in diameter by 21½ in. high over all, and weighing only 200 lb.; it is also self-priming when the water is but 2 in. deep. The miners have named it "the electric sponge." The horizontal unit is small enough to be slung between the end plates of the shaft timbering, projecting only 8 in. into the shaft. Capacity of the combination is 175 gal. a minute at a depth of 150 ft.

Water connections from the discharge of the horizontal unit to the collar of the shaft, as well as between the two units, consist of 30-ft. lengths of all-rubber hose. No rigid pipe is used and there are no valves. Any throttling of the discharge to reduce the capacity is effected by a special screw clamp on the outside of the discharge hose immediately above the vertical pump.

Recent Developments in Steam Generation

A Sketch by George T. Ladd

DURING the last quarter century, as industry has advanced with enormous strides, the demand for power—for more and more power—has been unrelenting. How this demand has been met in the steam-generating field was sketched briefly by George T. Ladd, president of the Ladd Water Tube Boiler Company, in a recent address in Pittsburgh before the Engineers' Society of Western Pennsylvania. The higher pressures used, the subjects of water conditioning, pulverized coal, water walls and screens, air preheaters, low temperature distillation, dry quenching of coke, and recovery of waste heat were discussed by him in an authoritative way, as set forth in the succeeding paragraphs.

The first response to this demand was the development of the steam turbine, which, in single units, had grown from 5,000 kw. in 1902 to 65,000 kw. in 1926, and to 208,000-kw. compound units in course of construction; the pressure at which these units operate had increased in the same period from 200 lb. to 1,200 lb.; the heat rate had decreased from 22,000 B.t.u. per kilowatt-hour in 1902 to 9,600 B.t.u. per kilowatt-hour in 1926.

Single power houses generating 30,000 kw. were mammoth affairs in 1920. Today single plants of 200,000 kw. are in operation and plants of 1,000,000 kw. in the process of construction.

Twenty years ago, the development of the stoker, combined with the better economies of the turbines, enabled the old boiler plants to carry the increased station output, but as pressures rose and units grew larger, the old boiler houses could not meet the demand, and the boiler maker began to study metallurgy and to turn his boiler shop into a machine shop to keep pace with modern industry. In 1920, boilers of 2,650 hp. each were installed for a large industry in Detroit, these being the largest ever built up to that time. They were then operating at 11,000 hp. each and producing 330,000 lb. of steam per hour. To indicate the marvelous improvements that have been made in the last few years, two of these boilers have been equipped with water-wall furnaces, increasing the total heating surface per boiler to 30,000 sq.ft., and each is now delivering continuously over 500,000 lb. of steam per hour and the latest one has produced over 600,000 lb. of steam per hour. Air heaters were installed, and the over-all efficiency of these units producing the larger output is about 1 per cent greater than that of the original units.

In New York City, one year ago, three boilers were installed designed to deliver 325,000 lb. of steam each. They are actually producing 350,000 lb. of steam each, and this output is limited only by the size of the fans. The fourth unit has just gone into operation and is producing 450,000 lb. of steam in the same space as one of the original units. Studies now being made on the fifth boiler indicate that a unit can be designed that will produce 750,000 lb. of steam in a similar space, and it is not improbable that before ten units are installed in this plant one will be designed to produce 1,000,000 lb. of steam in a similar space.

It is interesting to note that the limiting feature is not in securing proper materials, in burning the required amount of fuel, in absorbing the heat in the boiler, or in providing for proper circulation, important as they are, but in providing for smokeless combustion.

As explained before, pressures have increased from 250 lb. to 1,400 lb., and in some foreign plants 3,200 lb. is being experimented with. One of the properties of water is that as the pressure increases, steam bubbles, released in boiling, decrease in size, and, at 3,200 lb. pressure, boiling, as we know it, is nonexistent; the water passes into steam with no ebullition.

There are three steps in pressures for power houses in general use in this country. They are:

(1).....160 lb. to 450 lb.
(2).....550 lb. to 800 lb.
(3).....1,400 lb.

1. Many plants are still in service at 160 lb., but these are small and relatively unimportant. A great many plants are in operation at 250 lb., and these are fairly new. The upper limit of this type of plant is 450 lb., because, above this pressure, the steam, in passing through a turbine, loses its superheat, with an initial temperature of 725 deg., which is the limit today with materials now in general use. The steam condenses, and the condensed steam cuts the blades in the lower pressure section of the turbine. It then becomes necessary to pass the steam through a reheater to give it a certain amount of superheat and, if we do this, it is more economical to go to the next range of 550 to 800 lb.

2. These pressures are limited by the fact that the high-pressure turbine and the low-pressure turbine can be on a single shaft with the generator. The steam passes into the high-pressure turbine, at 550 to 800 lb. and 720 deg. F. total temperature, and, depending upon the design of the turbine, is discharged at 400 to 250 lb., and, containing 15 to 30 deg. F. superheat, is reheated to 720 deg. F. by being conducted back to a superheater in the same boiler setting as the primary superheater, or through a separate boiler especially designed for the purpose, or heated to approximately the temperature of the high pressure of the steam through a live-steam reheater located at the turbine, or some combination of the above systems may be used. When the pressure is about 800 to 900 lb. it is more economical to build the high-pressure and low-pressure sections in two separate units, each with its own generator.

3. At 1,400 lb., the high-pressure section is usually designed to operate at 3,600 r.p.m. and the low-pressure section at 1,800 r.p.m. The high-pressure section, which has from one-fourth to one-third the capacity of the low-pressure section, is the most efficient part of the unit and for some recent plants under consideration is slightly less in cost per kilowatt. The method of operation is as described for the preceding pressure, the steam passing through the high-pressure turbine, thence to a reheater and back to the low-pressure turbine. The turbine takes up very little space and is usually set near the boiler to simplify piping. This pressure was chosen because it was felt

it was not too high for metals which were known; valves and fittings could be constructed without too great a departure from adopted practices; and the pressure was low enough so that the difference in density between water and steam was still great enough to produce good boiler circulation. Three such installations are now in operation, and the troubles have been less than expected.

Other recent improvements which have been concurrent with and necessary for the increased output of boilers are:

(a) Water conditioning.
(b) Pulverized coal.
(c) Water walls and screens for furnaces.
(d) Air preheaters.

Water Conditioning

If boiler water contains only 12 grains of foreign matter per gallon (this is considered very good boiler water), and the boiler is evaporating 500,000 lb. of steam per hour, the boiler will receive over 100 lb. of foreign matter per hour if none passes over with the steam. This would be over a ton every 24 hours, so it is readily seen that it becomes necessary to consider proper water treatment. It is usually necessary to distill the boiler feed water, and as the make-up in a modern station usually does not exceed 3 per cent, this does not present a serious problem. Pure water, however, is a wonderful absorber of oxygen. When the oxygen is carried into the boiler it usually attacks the metal of the drum or tubes and seems to do so more readily at higher temperatures. Therefore, it is necessary to remove the free oxygen from the feed water before passing it into the boiler.

Pulverized Coal

The 2,650-hp. boilers previously described were fired by pulverized coal. This was one of the first, if not the first, large installations to use pulverized coal for firing boilers. Since then many other installations have been made, with more under construction, and it is safe to say that no boiler installation goes in today without pulverized coal being considered. Stokers have been perfected and are still being installed, but in developing a design to secure the maximum output of a large boiler in a small space, nothing will take the place of pulverized coal. It would have been difficult, if not impossible, to secure the large steam outputs described without the improvements that have been made in the method of burning coal.

To be concluded

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Detecting Leaks

An ear-phone listening device, known as the Transmit-O-Phone, which is intended for locating defects in power-plant machinery and motors, and leaks in pipe lines, leaking valves, hidden or underground pipes, and the like, has been announced in improved form by the International Metal & Specialty Company, Berlin, N. J.

PATENTS

POWER SHOVEL. No. 1,665,378. April 10, 1928. E. E. Peterson, Carson Lake, Minn.

Certain features in a power shovel adapted for tunneling in a restricted space.

PULVERIZER. No. 1,666,124. April 17, 1928. E. H. Elzemeyer, assignor to American Pulverizer Company, St. Louis.

MICA-SEPARATING. No. 1,666,130. April 17, 1928. L. T. Frederick, assignor to Chicago Mica Company, Valparaiso, Ind.

BRIQUETTE. No. 1,666,312. April 17, 1928. W. B. Runyan, Dayton, Ohio.

A metallurgical briquette comprising ground coke, a silicon sand and lime.

ROTARY FILTER. No. 1,666,381. April 17, 1928. H. S. Hele-Shaw, Reginald C. B. Stillman, and J. A. Pickard, London.

This filter makes use of the principle of stream-line filtration.

ROCK DRILL. No. 1,666,383. April 17, 1928. A. T. Holman and P. M. Holman, Camborne, England, assignors to Holman Brothers, Ltd.

ROCK DRILL VALVE. No. 1,666,427. April 17, 1928. William A. Smith, Jr., assignor to Ingersoll-Rand Company.

CRUSHER. No. 1,666,530. April 17, 1928. John A. Dormer and J. T. Malone, Detroit, Mich.

CABLE CLAMP. No. 1,666,885. April 24, 1928. A. O. Austin, assignor to Ohio Brass Company, Mansfield, Ohio.

BIN GATE. No. 1,666,908. April 24, 1928. R. S. Moore, assignor to American Smelting & Refining Company, New York.

METAL CASTING MACHINE. No. 1,666,910. April 24, 1928. H. C. Poske, assignor to American Smelting & Refining Company, New York.

LUBRICATOR. No. 1,666,959. April 24, 1928. O. E. Clark, assignor to Denver Rock Drill Manufacturing Company, Denver, Colo.

DRILLING TOOL. No. 1,667,156. April 24, 1928. M. P. Holmes, assignor to Sullivan Machinery Company.

A mechanism for driving a drilling tool by a flexible transmission shaft and gearing.

GAS PRODUCING PROCESS. No. 1,667,272. April 24, 1928. H. H. Smith, Johannesburg, South Africa, assignor to Minerals Separation North American Corporation, New York.

A process of producing a gas which consists in passing steam and a restricted amount of air through a mixture including sulphur-bearing material and carbon to produce a gas consisting largely of hydrogen sulphide.

GYRATORY. No. 1,667,337. April 24, 1928. W. S. Weston, Columbia, S. C.

TUYERE WINDBOX. No. 1,667,571. April 24, 1928. H. W. Titgen, Philadelphia, Pa.

This covers a windbox for a cupola furnace.

WELDING. No. 16,948. May 1, 1928. A reissue on welding and cutting apparatus, granted to Frederick W. Becker, East Rutherford, N. J.

LUBRICATION. No. 1,668,003. May 1, 1928. C. R. Bucket and T. E. Baker, assignors to trustees of the California Holding Company.

A grease measuring and dispensing apparatus.

ART OF WELDING. No. 1,668,090. May 1, 1928. Lorillard Spencer, New York.

CUT-WELD TORCH. No. 1,668,107. May 1, 1928. A. F. Dillon, Chicago.

MACHINE FOR RECOVERING PRECIOUS METALS. No. 1,658,162. May 1, 1928. Charles Loveridge and A. E. Cox, Portland, Ore.

FLOTATION. No. 1,668,202. May 1, 1928. George G. Griswold, Jr., and G. E. Sheridan, Butte, Mont.

A process of concentrating by froth flotation an ore containing sulphides of lead, copper, zinc, and iron, by treating it with a halogen to inhibit the flotation of zinc and iron sulphides, and subjecting it then to flotation in which the lead and copper sulphides are in large part recovered and the flotation of the zinc and iron in large part inhibited.

MINER'S PICK. No. 1,668,252. May 1, 1928. T. B. Scenter, Chattaroy, W. Va.

FISHING TOOL. No. 1,668,254. May 1, 1928. A. B. Scott, Long Beach, Calif.

HOIST. No. 1,668,284. May 1, 1928. R. C. Osgood, assignor to Sullivan Machinery Company.

This appears to be a hoist for diamond drill.

PIPE CLAMP. No. 1,668,499. May 1, 1928. George Geiser and Peter Latsch, Helena, Mont.

GREASE CUP. No. 1,668,510. May 1, 1928. Thomas P. Martin, Oklahoma City, Okla.

INDUSTRIAL NOTES

W. G. Owen has joined the sales force of the General Refractories Company, East Philadelphia. He will take charge of the Philadelphia territory, relieving L. Tschirky, who will devote his time to general sales promotion and developing sales of specialty products.

Arthur Farragut Townsend, president of the Manhattan Rubber Company, Passaic, N. J., celebrated his 25th anniversary as president on March 3 last.

The American Chain Company, Inc., Bridgeport, Conn., has purchased the business and trade name of the Wright Manufacturing Company, Lisbon, Ohio, manufacturers of chain hoists, trolleys, and cranes. No change in policy or sales organization of the Wright company is anticipated.

A license to manufacture Trulay "preformed" wire rope and the Tru-Loc processed fitting has been granted to the Hazard Wire Rope Company, Wilkes-Barre, Pa., by the American Cable Company of Chicago.

BULLETINS

COMPRESSORS, VACUUM PUMPS—Ingersoll-Rand Company, New York. Bulletin 3150, of 42 pages.

SUPERHEATERS—The Superheater Company, 17 East 42nd St., New York. Bulletin, 16 pages, entitled "Elesco-Operation."

STARTERS—Monitor Controller Company, Baltimore, Md. Bulletin 112. Thermaload starters. Twelve pages.

HIGH TEMPERATURE CEMENT—General Refractories Company, Philadelphia, Pa. A 22-page pamphlet entitled "Choosing a High-Temperature Cement."

GEOPHYSICAL PROSPECTING—The Radiore Company of Canada, Ltd., 426 Transportation Building, Montreal. A 20-page pamphlet entitled "Results."

FLEXIBLE COUPLING—W. H. Nicholson & Company, 12 Oregon St., Wilkes-Barre, Pa. Bulletin 627. Nicholson flexible coupling. Eight pages.

CONCRETE—Celite Products Company, Los Angeles, Calif. Bulletin 337. Specification sheet for architects and engineers covering the use of celite in concrete. Two pages.

NEWS OF THE WEEK

Summary

SIXTEENTH annual session of U. S. Chamber of Commerce, held at Washington May 8-10, was featured by discussion of a wide variety of important topics. The necessity for co-operative stabilization of American industry was particularly stressed. Page 830.

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The Patricia district looms as Ontario's third important gold-producing area. It comprises the Red Lake, Woman Lake, Favorable Lake, and Clearwater Lake fields. Page 829.

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Grandview Mines is erecting a 1,000-ton milling plant at its property in the Metaline Falls district of Washington. Operations are expected to begin on Sept. 1. Page 831.

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Star of Utah, in the Park City district, has begun to ship lead-silver ore to the U. S. S. R. & M. smelter at Midvale. Page 827.

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Russo-Asiatic Consolidated may dispose of its extensive holdings in Russia, according to Leslie Urquhart, chairman of the board of directors. It is rumored that Lena Goldfields are after the Russo-Asiatic properties. Page 832.

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Lake Shore has purchased McIntyre Porcupine's shaft-sinking equipment for installation at its new shaft. The first 500-ton unit of Paymaster's new concentrator has been started. Page 832.

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Reopening of the old Atlantic mine and adjoining properties in the Michigan copper district is being considered. Page 827.

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Shattuck-Denn has ordered a new electric hoist for its Denn shaft at Bisbee, Ariz. Page 828.

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Purchase of the Lorne group in the Bridge River district of British Columbia by Stobie, Forlong & Company, of Toronto, is announced. Page 828.

Increased Funds for Bureau Stations Disapproved by Director of Budget

U. S. Bureau of Mines Is Investigating Possibilities of Recovering Ilmenite as a Byproduct in Reduction of Titanium Ores

By PAUL WOOTON
Special Washington Correspondent

LEGISLATION proposing to increase the research program of the U. S. Bureau of Mines at its experiment stations and to increase the number of stations engaged in this work has been disapproved by the Director of the Budget as contrary to the President's own financial policy. This applies to the proposed large station at Salt Lake City, as well as to the existing stations, and to the Berkeley, Reno, and Moscow stations, which have been recommended for inclusion under the Foster act. Senator Oddie, of Nevada, the chairman of the Committee on Mines and Mining, expects to attack this action in a speech on the floor of the Senate. In connection with the announcement from the Budget Bureau, Senator Oddie made public the letter of Director Turner of the Bureau of Mines in support of the measure. It follows: "Senate bill 2079 has the strong approval of the Bureau of Mines. It is a practical means of aiding the mineral industries by eliminating waste through increasing scientific knowledge and improvement in technical processes. The experiment stations were established in their several localities to conduct scientific and technologic research. Each of seven of these stations established under the Foster bill receives an annual appropriation of $25,000. Two stations, Reno, Nev., and Berkeley, Calif., are supported out of an appropriation for Mineral Mining Investigations, although the type of work carried on is similar to that of the Foster stations. These two stations, Reno and Berkeley, should be included in the system of Foster stations and appropriated for in the same bill. If this were done, there would be nine Foster stations, the bill authorizing ten.

"The Reno station was allotted $22,250 for the current year and the Berkeley station was allotted $13,260. These amounts are obviously too small for the maintenance and efficient operation of an experiment station, but even these small sums cannot be counted on with assurance, since more urgent demands on the Mineral Mining Investigations appropriation (which totals only $99,570) may necessitate the diversion of funds from allotment to these two stations.

"The mineral industries are served in several ways by appropriations to the Bureau of Mines, notably by its investigations under appropriations for mine accidents, rescue cars and stations, fuels, mineral resources, and oil and gas. The investigations at the experiment stations and investigations in mineral mining are the ones having to do more largely with metal mining, where there is a growing feeling that their problems are not equitably considered. Increasing the fund for the stations and relieving the Mineral Mining Investigations appropriation of the support of the Reno and Berkeley stations would apply increased support in the many places where it is needed most. In the conduct of these stations, the Bureau has been forced to the conclusion that $25,000 is too small an amount to effectively support an institution. It is necessary to maintain an organization for general direction of such stations and a small organization to conduct the business of each station, and this mechanism could direct a considerably larger productive force. Each fund is so small that only about two problems can be undertaken at a time, with four to six productive workers, and the problems selected must be restricted to those calling for small amounts of money.

"The present purchasing power of the dollar is such that, were the dollars doubled, as proposed, the increase in purchasing power would be only about 20 per cent greater than when the stations were started in 1915.

"These stations have proved as effective in their way as have the agricultural experiment stations in their field. The agricultural stations have had greatly enlarged support and have been increasingly effective in their service, which warrants the belief that similar results would follow the strengthening of mining experiment stations."

The great demand which has grown up for titanium pigments has in turn created a market for ilmenite—titanium

iron oxide. The only known subsurface deposits of this material rich enough to be worked are in Norway. American production has been confined to beach sands near Jacksonville, Fla. The United States is importing the material, however, from Brazil, India, and West Africa. On the beaches where the ocean has acted as a concentrator the material frequently runs better than 52 per cent TiO_2. There are deposits in the United States, however, which carry 8 to 16 per cent TiO_2. The U. S. Bureau of Mines is looking into the possibilities of the recovery of this material as a byproduct in the reduction of titanium-bearing iron ores.

There is a prospect for the opening of mining operations on the Nelsonite deposits in Virginia, which carry even a higher percentage of ilmenite. Titanium paints have a greater covering power than those using other pigments, with the result that they are coming into general use, with prospects pointing to a sharp upturn in the amount consumed.

Cost studies of crushed stone, building stone, and sand and gravel have been begun by the Building Materials Section of the Division of Rare and Non-Metallic Minerals of the Bureau of Mines. All phases of costs are to be considered which arise in the removal of overburden, in quarrying, in crushing, and in marketing. Overhead expenses also are to be calculated. The work is being done under the direction of J. R. Thoenen.

Star of Utah Mine at Park City Begins Shipping to Smelter

SHIPMENTS of lead-zinc-silver ore have started to the Midvale smelter of U. S. Smelting, Refining & Mining from the Star of Utah mine, situated in the Park City mining district of Utah. Within a short time, production is expected to reach 30 tons a day and to increase steadily thereafter as development of the property proceeds, thereby placing the mine among the regular producers of the district tributary to the Salt Lake smelters.

Exploration and development operations have been under way for several years on the 1,200-acre tract that the Star of Utah Mining Company controls. The latter part of May a corps of engineers from the mining department of the U. S. S. R. & M. company will make a thorough geologic study of the ground, with a view of assisting the Star of Utah in the development of its territory.

Workings at the property consist of a 2,900-ft. tunnel and an inclined winze 200 ft. deep. The tunnel, which is being advanced at a rate of 5½ ft. a day, is expected to encounter the Wabash fissure at a distance of 6,000 ft. from the portal, and the Wasatch, Homestake, and Naildriver fissures at intermediate points. These fissures are all expected to be productive on the property, as they are well-known zones of mineralization in the district and as ore has been followed in the Naildriver ground up to the Star of Utah territory. In 1908 and 1909 ore was developed through the old Wabash workings in what is now part of the Star of Utah holdings; the property, therefore, has definite objectives ahead.

The inclined winze was sunk on a fissure 800 ft. from the portal of the tunnel; this work developed two oreshoots, 2½ to 5 ft. wide. A vertical raise on an oreshoot is being driven from the bottom of the winze to the main tunnel, and, when this is completed, the winze will be extended 300 ft. vertically. The resultant vertical working, approximately 400 ft. below the tunnel level, will then be stripped to form a three-compartment shaft.

The main tunnel, at the points where the various fissures are expected to be cut, will be 1,300 to 1,800 ft. below the surface. Following the driving of the tunnel to the Wabash fissure, and the sinking and stripping of the winze, lateral development of the various fissures will be started.

Surface plant at the property includes a new Ingersoll-Rand compressor installation, office building, superintendent's quarters, a large bunkhouse, and a boarding house.

Atlantic Mine in Michigan May Be Reopened

A PROJECT under consideration in the Michigan copper district is the reopening of the old Atlantic mine, now the property of Copper Range. It is proposed to combine the Atlantic with the Pacific and other properties of St. Mary's Mineral Land and turn the combined acreage over to Champion Copper for opening and operation. The present holdings of the Atlantic are insufficient to warrant reopening, making the acquisition of the other properties essential. The enlarged area will probably be mined through the Atlantic's deepest shaft, toward the northwest apex of the property, and a new shaft which will be sunk in an outcrop in new territory. If the old shaft cannot be unwatered, two new shafts will be driven. This project is not connected with the exploratory program, announced in *Engineering and Mining Journal* of May 12, which Champion Copper will carry out to the north of its mine.

Calumet & Hecla Consolidated continues to enjoy a favorable labor situation. In the Osceola and conglomerate shafts, 600 more men are being employed underground than were at work a year ago.

In the company's No. 9 shaft, pillar mining is now approaching the 57 level. It is estimated that at least fifteen years will be required to mine out the remaining copper rock above the 81 level haulageway. Pillars in the mine are 100 to 150 ft. long and 10 ft. wide on either side of the shaft. In the upper levels the backs of stopes are also being removed.

Resumption of operations at Quincy's stamp mill, following a recurrence of the "air blasts" which have been troubling this Michigan producer, is announced. It is handling rock from the new drifts in the No. 6 shaft. The mill will not be run at capacity, however, until No. 2 shaft is repaired. Probably three or four months will elapse before this shaft, which was damaged by fire last October, will be restored.

Removal of Australian Tariff on Pyrites Is Asked

An application has been made to the tariff board of the Australian commonwealth by a representative of the Rio Tinto Company, London, for the removal of the duty on imported pyrites. Although a bounty is paid by the government on locally produced sulphur, the production has declined in recent years, whereas the importation of brimstone sulphur has increased. Rio Tinto desires to ship pyrites to Australia and is prepared to co-operate with users of sulphur in Australia by erecting modern roasting plants. As the price of brimstone sulphur has recently increased from £4 10s. to £6 a ton, it is claimed that the erection of roasting plants to operate on imported pyrites would be a sound business policy.

Movement for Smelter at Denver Is Growing

JOHN T. JOYCE, state mining commissioner of Colorado, who is chairman of the committee of the Colorado Metal Mining Association appointed to consider the erection of a smelter at Denver, says that sentiment in favor of such a plant is growing. The committee points out that ore mined and milled in the Boulder and Idaho Springs districts, within 30 miles of Denver, must be sent to Leadville for smelting. Leadville is 150 miles from Denver via narrow gage or 270 miles via the D. & R. G. W. railroad.

Purchase of the Hercules-Ajax mine, on Belvedere Mountain, in northern Gunnison County, Colo., by the Green Investment Company, of Tulsa, Okla., is reported. The consideration for the mine, which carries silver-lead-zinc ores, is said to have been $65,000.

Headframe at Imperial Mine Damaged by Lightning

The headframe of the Ford Motor Company's Imperial mine at Michigamme, Mich., was struck by lightning on May 12. The fire which followed damaged the steel to such an extent that the greater part of the frame will have to be replaced. Hoisting of iron ore will not be possible until repairs are completed. The mine may be idle for at least two months.

More Fundamental Flotation Data Determined

Department of Mining and Metallurgy of Utah University Continues Studies Begun Last Year

NEW and important data are being determined in the course of the fundamental flotation research studies now in progress at the laboratories of the Department of Mining and Metallurgical Research of the University of Utah. Following the work of last year, the results of which were published recently as Technical Paper No. 1 of the department, the studies this year continue with chalcocite, malachite, azurite, and sphalerite as the minerals under consideration.

Work with chalcocite has shown many collecting agents to be more effective than ordinary xanthate, several being at least five times more active. It was found also that certain salts were deleterious to the flotation of the mineral, and that these should be eliminated from the circuit if the chalcocite was to be floated, or added in suitable amount if it was to be sunk.

In experiments with malachite and azurite, the latter was separated from the former by employing fatty acids—a surprising result, inasmuch as the minerals are similar chemically. Success was also had in separating malachite or azurite from quartz, feldspar, fluorite, iron oxide, and other associated gangue minerals; the recoveries made exceeded 95 per cent in many instances. It is planned to extend this study to include the separation of mixtures of metal-bearing carbonates and to oxidized ores.

In the course of effecting separations of malachite from calcite, at a constant temperature of 20 deg. C, it was found that a conditioning time of ¼ min. resulted in a 96 per cent recovery of malachite; a conditioning of 2 min. gave a recovery of 80 per cent; a 5 min. conditioning a 56 per cent recovery; and only a 40 per cent recovery was made following a conditioning period of 10 min.

With the conditioning time kept constant at 2 min., a 98 per cent recovery of malachite was made under a temperature control of 0 deg. C; an 80 per cent recovery resulted with the temperature at 20 deg. C; a 60 per cent recovery at 50 deg. C; and only a 30 per cent recovery with the temperature at 90 deg. C.

Considerable difficulty was experienced in duplicating any set of results with sphalerite, because of the presence of traces of copper in the tap water used. This copper content did not exceed one part in 20,000,000, but that was sufficient to influence the floatability of the mineral. A study of the effect of collectors on sphalerite showed that in the absence of copper or lead salts the mineral was only slightly floatable in neutral circuits. The presence of copper and other salts, moreover, resulted in the formation of covellite and other sulphide coatings on the surfaces of the sphalerite.

During the current year, these flotation research studies will include other sulphides, such as chalcopyrite, marmatite, and realgar; considerable time will be devoted to the determination of the effects of various reagents on mixtures of minerals, rather than on pure minerals alone; and later, the effect of finely disseminated gangue minerals will most probably be considered.

Prof. A. M. Gaudin is in charge of this work; associated with him are E. C. Haas, J. S. Martin, and P. Sorensen, holders of graduate fellowships in the department.

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Rand Mines Will Be Linked by Paved Road

SOUTH AFRICA'S "Main Reef Road," linking the gold mines on the Rand for 60 miles, will soon be converted into a modern improved highway, following the report of a commission which convened to make recommendations on the subject, according to reports received by the U. S. Department of Commerce from Johannesburg.

The "hot mix" system of construction has been adopted for the heavily traveled section of this road between the three-mile post, West Rand, and Benoni. This will consist of a hot asphaltic layer of specially prepared asphalt concrete laid on the present waterbound macadam. The remainder of the new road will be grouted, using 4 in. of ordinary broken stone.

The "Main Reef Road" follows the high ridge of the Witwatersrand and is subjected to as heavy wear as any stretch of road in South Africa. Its upkeep has always been a problem, not only because of traffic, but also because of damage from storms.

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Stobie Acquires Lorne Group in the Bridge River District

A CONTROLLING interest in the Lorne group, situated at Cadwallader Creek, in the Bridge River district of British Columbia, has been acquired by Malcolm Stobie, of Stobie, Forlong & Company. Lorne Gold Mines, of Nelson, Ltd., has been formed to develop the property. It is situated about 1,000 ft. above the Pioneer mine, and has an advantage over many properties, in that it may be developed by tunnels. R. B. Lamb, engineer for the Stobie interests, says that the vein system can be traced from the Pioneer to the Lorne. Two veins have already been exposed. Development will be started at once under the supervision of H. C. Wilmot.

The Pioneer has been a producing mine for three years, in which time it has paid for the erection of a 100-ton mill and the sinking of a shaft to a depth of 600 ft. Power should soon be available in large quantities in the district. British Columbia Electric Railway Company is constructing a 600,000 hp. hydro-electric plant in six units, the first of which will probably go into operation in the winter of 1929-1930.

T. J. Crabbs, president of Granby Consolidated, has announced that his company has sold 5,379 shares of stock at prices ranging from $50 to $51. The funds realized will be used for the development and equipment of the Bonanza mine, near Anyox, B. C. The mine will probably be brought to production early in 1929, and will produce an average of 250 tons a day.

The purchase of the Bullion placer mine by the Montreal Trust Company for $200,000 has been approved by Justice Murphy in the Supreme Court of British Columbia. The trust company has paid $10,000 into court to bind the transaction. The mine is in the Cariboo district, and in the early nineties was worked by Canadian Pacific Railway interests and later sold by them to Guggenheim interests. Since 1896 it has been in litigation. In the early days of its operation a large amount of gold was taken from the old placer mine, but more money has probably been spent on development, equipment, mining, and litigation than has been realized from gold taken from the mine.

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Electric Hoist Will Be Installed at Shattuck-Denn

AN ELECTRIC hoist has been ordered by Shattuck-Denn Mining from the Nordberg Manufacturing Company, of Milwaukee, for installation at its Denn shaft at Lowell, Ariz., in the Bisbee district. Purchase of the hoist was authorized by the board of directors last January, as a feature of the company's extensive development plans. The hoist will be equipped with Westinghouse motors and will have a hoisting capacity of 1,500 tons daily from a depth of 2,200 ft. Deepening of the shaft from the 2,000 to the 2,200 level will be started within the next 30 days.

A new 85-ft. steel headframe will be purchased and will be installed with the hoist after the shaft sinking is completed. Ore from the 2,000 level of the Denn shaft is brought to the surface in two lifts by two different hoists at present. The new hoist will greatly facilitate and speed up production. A railroad spur is also to be built to the shaft, replacing the tramway which carries the ore from the shaft to the railroad at present. Operation of the new hoist is expected to start in October of the current year.

Sinking of the Warren shaft of the Phelps Dodge Corporation at Bisbee has reached a depth of 1,800 ft., where a station will be established. Other stations are at the 700, 1,000, 1,200, and 1,600 levels. The shaft will be continued to the 2,000 level before drifting is started.

Leasers are active in the Big Bug district, described in detail in *E.&M.J.* of March 17, and in the Hassayampa district, near Prescott. Ruby Silver, located in the Hassayampa field, is the scene of activity. A tunnel, which has already been driven 474 ft., is being directed toward the Zero vein.

Clearing a creek in the Patricia district

Spring Thaw Will Enable Increased Activity in Patricia District, Ontario

Howey Gold at Red Lake and Jackson-Manion at Woman Lake Are Engaged in Construction Work—Prospecting in the Entire District Is Intensive

PORCUPINE and Kirkland Lake, Ontario's two established gold-producing areas, may soon be supplemented by a third—the Patricia district, including the Red Lake, Woman Lake, Clearwater Lake, and Favorable Lake fields. Work in these areas is severely hampered by the long winter, and consequently, with the coming of summer, prospecting and construction work is intensified. Red Lake will probably be the first of the various fields above mentioned to start production. At the Howey Gold property development is progressing steadily along the ore zone toward the west, and the amount of ore already in sight is said to be impressive. It is altogether likely that before many months have passed Howey will be equipped with a mill of large capacity. According to present plans, the actual construction work will be completed during the summer, and a part of the mill machinery will be taken in over the water route from Gold Pines to Red Lake. Some of the heavier parts will probably have to be left at Gold Pines for winter roads.

Dunlop Consolidated will undertake a campaign of diamond drilling on property situated a short distance northeast of the Howey. The Martin-McNeely will also make extensive exploration. Red Lake Centre and Nortricia are carrying out plans which offer promise of increases in work. Nortricia is the company holding the Smith-Morrison property, at which a wide deposit is being explored, while Red Lake Centre is owner of 23 claims lying adjacent to Howey on the northeast and south.

According to recent reports, preparations to begin active development work at the Bathurst company's properties are now fairly well advanced. The properties are situated between Caribou and Bathurst lakes, about three miles north of Narrow Lake, in the Red Lake mining division. A complete mining plant is being established. This plant will include air compressors, pumps, hoist, and other equipment, designed to sink a shaft to a depth of 1,000 ft. Reports also state that a Tremaine steam stamp mill has been ordered for the purpose of extracting the gold from the high-grade portions of the showing. The capacity of this mill, it is said, will be between ten and fifteen tons daily. Altogether, the properties controlled by Bathurst total approximately 1,200 acres, embracing the Bathurst, Price-Logan, Colburn, and the Daimpre groups.

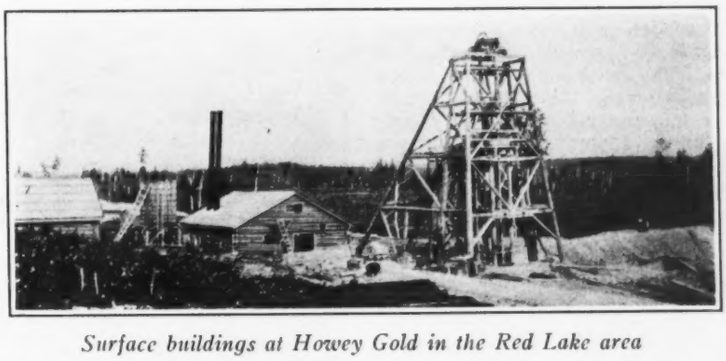
The Red Lake gold mining division has recently been enlarged and now includes what was formerly a portion of the Kenora mining division. It extends from the Thunder Bay mining division on the east to the Manitoba boundary. The main gateways to the district are Hudson and Sioux Lookout, reached by the Canadian National Railways. There is a canoe route via Quibell, which prospectors occasionally employ and which enables them to avoid the large body of open water on Lac Seul.

In the Woman Lake section, Jackson-Manion is rushing the construction of permanent buildings to house the increased staff of workmen made necessary to cope with development plans. A large amount of surface work, stripping, trenching, and sinking of test pits has already been carried out on the property. Many other companies have staked or acquired properties over a wide area in this section. Engineers who have returned from the field report that this camp is destined to be one of the busiest in northern Ontario.

Woman Lake and Narrow Lake are situated about 45 miles north of Red Lake. Discoveries were made in these areas in 1926. Some 400 claims were staked at Narrow Lake and an even greater number at Woman Lake. While the deposits appear to be of importance, the district is somewhat at a disadvantage because of the distance from transportation. Some progress, however, was made in this regard recently when a winter road was constructed into the area. Some of the large Canadian operators are interested in the claims at Narrow Lake, including N. A. Timmins and a group associated with Noranda Mines.

In the Clearwater Lake section, Consolidated M. & S., which has acquired an option on the Hill claims, has received the greater part of its plant. It is also reported that Coniagas Mines will in the near future resume development operations on its option, which is known as the Laidley group and on which the company had a large force of men working last summer.

Importance has been attached to recent discoveries of silver at Favorable Lake, some 150 miles north of Red Lake. A syndicate formed by Ken Murray, a Winnipeg engineer, put in supplies late last year, and work has been under way there since. A second syndicate is in the field, known as the Severn Syndicate — named after the river at the headwaters of which the discovery lies. The two syndicates hold about 3,360 acres of ground.



Surface buildings at Howey Gold in the Red Lake area

Moore Mine Tailings Will Be Worked by Amador

Amador Reclamation & Development, of Jackson, has been formed to work tailings at the Moore mine, near Jackson, Calif. Construction of a leaching plant is expected to start soon. W. Steele is president of the new company.

Co-operative Stabilization of American Industry

Record Meeting of Chamber of Commerce of U. S. at Washington Discusses a Wide Variety of Important Topics

WITH an attendance exceeding that of any previous meeting, the sixteenth annual session of the Chamber of Commerce of the United States began on May 8 in Washington. The proportion of outstanding figures in the business world present constituted a record.

The feature of the first day's session was the address of Judge Edwin B. Parker, chairman of the Board of Directors, in which he urged business to purge itself of that small percentage of "pirates" which tends to bring the whole into disrepute. They, he declared, break down public confidence and provoke government regulation.

President Lewis E. Pierson urged the maintenance of the Chamber's position on tax reduction—that government income and government expenditures should substantially balance. Large surpluses are an inducement for demands on Congress for extravagant spending, he maintained.

That the trade association has come to be a highly important part of the Chamber's membership was brought out strikingly. It is obvious that these organizations are destined to become an important part of the foundation upon which the national Chamber rests.

Under careful analysis, the factor of labor cost is usually one of the smallest factors in production. The high wages paid in the United States offer no reason why the American manufacturer cannot compete and succeed in the foreign market. These opinions, based on personal experience, were advanced by William C. Redfield, ex-Secretary of Commerce, who urged his hearers not to take a flier in foreign trade but to consider it as a serious and permanent venture. The finish, quality and design of American-made goods usually make price a question of secondary importance, but the manufacturer should not use the foreign market as a dumping ground for excess production. He should consider less the problem of selling what he wants to sell and study instead what his customer wants to buy.

Vast opportunities await the initiative of those who are ready to go abroad with a willingness to learn, with a flexible outlook, adjustable to the needs of every market. The foreigner and his idiosyncrasies must not be despised or his prejudices overruled. Failure is inevitable if express requirements are disregarded and substitutes offered.

Mr. Redfield cited the responsiveness of the American workman to leadership as an overwhelming advantage. Success in the foreign field, he declared, depends on whether or not the manufacturer has faith in himself, faith in his men and faith in his goods. If so, he can find ample opportunity for expansion abroad if he enters the foreign field with the intention of staying in it, changing his own policies and practices from time to time to conform to a new knowledge of the needs of his customers.

The day of integrated mass trade effort, as a sequel to mass production, is at hand, according to Julius Klein, Director, Bureau of Foreign and Domestic Commerce, Department of Commerce, who spoke on "Foreign Trade Combinations."

The situation, he says, calls for sober factual analysis, calm planning, and courageous action; not emotional patrioteering on the one hand or supine defeatist submission on the other.

It was hoped that in the Webb-Pomerene combines had been found the answer to foreign collaborative competition, but a decade of the operation of that act has revealed unexpected obstacles. Although some 57 export associations are registered, only a small proportion are actively operating. Their total export trade in the last fiscal year was about $200,000,000, a third of which was supplied by metals and minerals.

The bulk of the commodities availing themselves of the privileges of the act were raw materials, whose uniform character made them readily susceptible to such consolidated handling. Particularly in regard to the raw materials mentioned, this type of trade device seems to have served a useful purpose.

As a further protection against consolidated selling, discussion has arisen regarding the possibility of consolidated buying. The Newton bill, recently defeated in Congress, proposed such a device, and somewhat similar measures and practices have been in use for years in other countries, notably in regard to bauxite, vegetable oils, zinc, manganese and iodine. With proper safeguards under the strict supervision of regulatory governmental agencies, the arrangement has much to commend it. Indeed, the discussion of it clarified the international situation by serving notice upon foreign producers that an attempt on their part to exploit the consumer by means of unwarranted price manipulation would stimulate the creation of such protective agencies. Doleful observations have been made that by proposing to authorize such temporary import defensive measures, we were indulging in the same form of criminality we were condemning in foreign export circles. Careful comparisons, however, of the two projects—collaborative buying and collaborative selling — reveal them as being of diametrically opposite type and purpose.

In the minds of these critics who denounce any defensive spirit, apparently the only response we should make is that of complete passive submission. However vicious and unscrupulous the operations of foreign combines might be (and more than one instance of just such rapacity has occurred in recent years), we should under no circumstances meet aggression with aggression, so we are told, but rather undertake to reason with our assailants, to point out the error of their ways, and to dispel their dark intentions by the force of economic logic!

In the presence of the burly realities of the trade rivalries and acquisitive asperations of today, such amiable academic sophistry is nothing but solemn nonsense. The best defense and the only honorable one is by co-ordinated action under such proper restraints as are necessary in the public interest.

The prospective exporter who is delaying sales efforts overseas for fear of possible credit losses is making a serious error. It can be asserted without fear of contradiction, affirmed E. B. Filsinger, president of the Export Managers' Club of New York, that such losses average only from $\frac{1}{3}$ to $\frac{1}{2}$ of 1 per cent. Only in exceptional cases do they run as large as 1 per cent. When credit is extended unwisely, of course, whether abroad or at home, the results may be costly. Yet with the facilities available for obtaining credit information on foreign houses, no excuse can be offered

Harris & Ewing

Building of Chamber of Commerce at Washington, D. C.

for a high ratio of loss. That a business program in legislation is seriously needed was the gist of an address by Benjamin Loring Young, under the title "Organized Effort for Sound Legislation." Mr. Young advocated the introduction of machinery for acquainting business men in particular and the public at large with the successive steps of legislation as it is proposed and while in process of enactment.

Stating that the present complicated legislation regarding capital and finance, which differs in almost every state, imposes a burden upon legitimate financial undertakings, Henry R. Hayes, president of the Investment Bankers' Association of America, urged that American business take steps to simplify financial legislation and eliminate much of the red tape which hinders public purchase of legitimate securities.

Following along the general line of tax reduction discussed at the meeting of the Finance Department, Felix McWhirter, president of the Peoples State Bank of Indianapolis, said that local business organizations can wield great influence in the reduction of local city and state taxes.

Local taxes are just as subject to reduction as federal taxes, according to Mr. McWhirter, and business can be saved huge sums yearly by ascertaining where local taxes are high and recommending plans for their reduction.

At the luncheon meeting of the manufacturing group, E. J. Mehren, vice-president of the McGraw-Hill Publishing Company, proposed that (1) we supplant the craze for volume by a reasonable passion for profits, and (2) that we eliminate buyers' profiteering with its accompanying price cowardice. Mr. Mehren said, in part:

"At the very root of our difficulties lies the craze for volume. We'd sooner have volume than profits. A full factory and red ink seems as popular as 70 per cent operation and plenty of black."

Admonishing the seller to be careful of his own ethics in buying, because he is also a buyer, Mr. Mehren said:

"You, Mr. Manufacturer, are an outraged seller. You are not human if you have not chafed under the conditions. But has it occurred to you that you, too, are a buyer? Is your purchasing agent a profiteer and a price clubber? Are you practicing on others what you condemn when practiced on you?

"Put your own purchasing right and the reformation will have been started. You can, then, with clean hands carry this propaganda into your own circles of influence."

Another address delivered at the luncheon meeting of the manufacturing group, important because of its wealth of detail, was that of Donaldson Brown, vice-president of the General Motors Corporation, on "Forecasting and Planning."

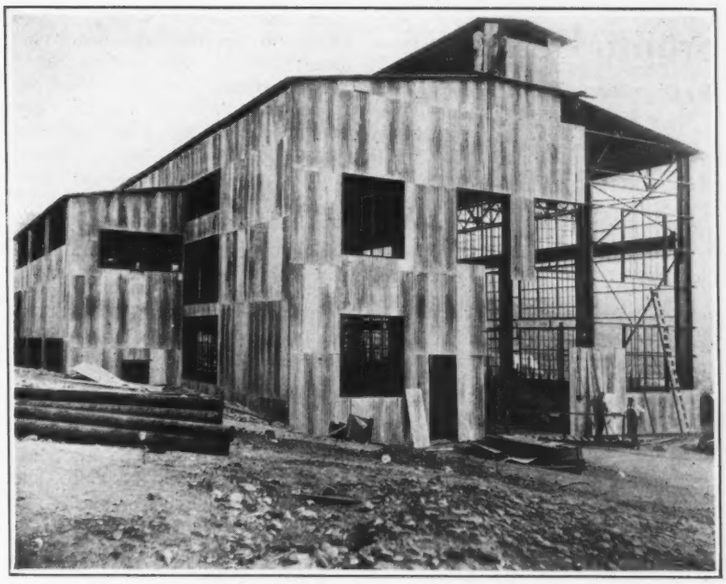
The Chamber, in general session, put its formal stamp of approval on the principles set forth in the keynote address of Judge Edwin B. Parker. In a resolution, unanimously adopted, unethical practices in business were condemned and stockholders were told that they "cannot accept the profits flowing from corruption and escape the moral stigma which inheres in such profits."

The resolution declared further that American business "insists upon protecting its professional status by the maintenance of the highest standards and intends scrupulously to discharge its collective responsibilities."

The Board of Directors, in recommending the resolution, did not wait for this declaration of policy to take the usual course. It was adopted at a special meeting of the Board and brought before the general session, where all the delegates were assembled. It was adopted unanimously amid a scene of great enthusiasm.

At the annual dinner of the Chamber on May 10, Dr. Alberto Pirelli, of Milan, Italy, president of the International Chamber of Commerce, issued a warning that the United States cannot go on indefinitely receiving yearly an increasing amount of interest and sinking fund payments on its loan and investments abroad and maintain its present tariff policy and export trade.

"The problem," he said, "is a difficult one indeed. The declaration that new economic forces are in action and that the United States can thus go on lending money abroad is certainly a cogent argument. Yet the question arises—if the United States continues lending money abroad at the present rate of a billion and a half dollars annually, and if in addition to this amount they reinvest abroad the interest accruing on previous loans and investments, their total credit from the rest of the world may reach in a comparatively few years so large an amount that some claim the liquidation of the balance may be on a scale out of proportion to the volume of world trade."



Main mill building of Grandview Mines, Metaline Falls, Wash.

Grandview Mines Erecting 1,000-Ton Milling Plant

CONSTRUCTION of a 1,000-ton milling plant for the Grandview Mines Company at Metaline Falls, Wash., is going ahead rapidly, and operations are expected to begin about Sept. 1. The plant consists of a 60 by 120 ft. main mill building, and a crusher building, measuring 60 by 90 ft. Both structures are of steel construction throughout, and represent an expenditure of over $125,000. Erection of the plant is in charge of the Eastern Iron & Metal Company, of Salt Lake City.

Equipment in the main mill building includes two 8x6 ft. Marcy ball mills driven by two 225 hp. General Electric slip-ring motors and fed from conveyors, passing over Merrick weightometers; two Model D heavy duty 6x22 ft. Dorr classifiers, operating in closed circuit with the ball mills; and, an overhead traveling crane, operating the full length of the building. A complete flotation plant will also be included in the milling equipment.

The crusher building will house an Allis-Chalmers Style K No. 8 gyratory crusher, having a capacity of 3,000 tons in 24 hours, and a set of 54x20 in. Traylor HA type heavy-duty rolls.

Ore reserves of the property are estimated at 2,000,000 tons.

Moose Creek Placer Grounds Operating on Small Scale

The old Moose Creek placer grounds, on the south fork of the Clearwater River, in north-central Idaho, one of the state's most historic placer diggings, were recently purchased by a Kellogg (Idaho) corporation from W. H. Giles, who had been operating the grounds for a number of years. The company is known as Moose Creek Placer Company.

These placers, which are estimated to contain 2,500,000 cu.yd. of gravel, were first discovered in 1863.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Shaft Sinking Will Begin at Lake Shore—First Unit of Paymaster Mill Starts

TORONTO, MAY 12, 1928.—Lake Shore Mines, in the Kirkland Lake district of Ontario, has purchased the hoist, motor, and accessories used in sinking the No. 11 shaft of the McIntyre Porcupine Mines to a depth of 4,000 ft. This equipment will be installed at the new shaft of the Lake Shore, which is now down 800 ft. Raises are being put through below that level, which will provide for a depth of 2,000 ft. The main vein is being opened up on the 1,600 level, where 600 ft. of ore, said to average $20 a ton, has been developed.

Some of the properties in the vicinity of Dome Mines in the Porcupine district are asking for an extension of the Dome railroad spur. Among the properties that would benefit from the cheaper freight costs, which would result, is the Paymaster. The first unit of the new 1,500 ton concentrator at this mine was recently started. This unit has a capacity of 500 tons a day. The ore at the Paymaster is low grade. Mill heads are not expected to exceed $3 a ton, from which concentrates averaging $25 to $30 a ton will be made. Concentrates will be treated in the cyanide plant, which has a capacity of 350 tons a day. An underground electric haulage system has been installed and an underground crushing plant is being put in at the 300 level.

DEVELOPMENTS on the 250 level of the Waite-Montgomery property in Quebec are said to be better than diamond drill indications. The first crosscut at this level cut through high-grade zinc, but a branch drift recently reached the copper zone, and 45 ft. of copper ore has been opened. This ore carries practically no zinc and will be shipped direct to the Noranda smelter. Shipments are expected to start in July and will be at the rate of 200 to 250 tons a day. At the Horne mine of the Noranda, which controls Waite-Montgomery, the main shaft is now down below 1,000 ft. The smelter is treating 750 tons a day. This tonnage will be increased in the summer by shipments from the Waite-Montgomery and by concentrates from the new 500-ton mill when it starts operations.

The new mill of the Coniaurum mine in the Porcupine district, which is controlled by Coniagas Mines, will be in operation by the middle of June. The mill has a rated capacity of 500 a day, but it is not expected that more than 300 tons a day will be treated for some time. Development work at the mine is being done on the 2,000 level though ore has not yet been found there.

Shaft sinking has been started at the Mandy Mines, in northern Manitoba. The first objective will be 600 ft. Diamond drilling has been carried to about 300 ft., and satisfactory results are reported. Between 1917 and 1920 more than 9,000,000 lb. of copper was produced from the Mandy claims. Ore had to be hauled to water transportation and then shipped to The Pas and sent to the Trail smelter for treatment. It is estimated that above the 200 level about 100,000 tons of high-grade ore is left and that in addition to this there is at least 100,000 tons of ore of somewhat lower grade.

Good progress is being made with the Flin Flon Railway, and practically two-thirds of the line has already been completed. Some of the most difficult sections of the road still remain to be built. It is not likely that the laying of steel will be completed until the fall.

Mexico City Letter

BY W. L. VAIL
Special Correspondent

President of Mexican Mining Chamber Finds Industry in Good Condition

MEXICO CITY, MAY 7, 1928.—According to Genero Garcia, president of the Mexican Mining Chamber, general conditions of the industry for the first quarter of the present year were on the whole satisfactory. Individual exceptions occurred, of course. One of the difficulties mine owners encounter, according to Mr. Garcia, is the law requiring the employment of Mexican mining engineers entitled to official designation as such, as there is a shortage of these engineers. Low metal prices, on the whole, have been offset by the high standard of efficiency reached in many camps.

Mr. Garcia believes that the total output for 1928 may be less than that for 1927, because of the exhaustion of the high-grade reserves in many mines. It appears to be the general impression that labor conditions are constantly improving, and that the attitude of the government in respect to this problem has been impartial.

ENGLISH financiers interested in the proposed custom mill in the Tavichi district, State of Oaxaca, are en route from London and are expected to study the situation carefully. A large number of properties in the district have been optioned in view of the possible entrance of new capital into the camp. Work has begun on an automobile road from Oaxaca to Tehuantepec. This road will provide an outlet to the Pacific Coast for a number of important mining properties.

Work has been started on the Rey and Anexas property, near the city of Victoria, Tamaulipas, and a number of extra men were put to work during the last month.

London Letter

BY W. A. DOMAN
Special Correspondent

Russo-Asiatic May Dispose of Its Extensive Holdings in Russia

LONDON, MAY 1, 1928.—At the annual general meeting of Russo-Asiatic Consolidated last week, Leslie Urquhart, the chairman, said: "In connection with our Russian interests, we were approached recently by one of the principal American financial and mining groups. Negotiations have not yet reached the stage at which it is possible for me to say more at the moment, but you may rest assured that, if matters proceed to a point where it is possible to make a statement, shareholders will be informed at once. But we have met with so many disappointments in the past in connection with our Russian interests that I would respectfully warn you not to be too optimistic of a successful outcome to these negotiations. The fact, however, that we have been approached by such a powerful American group, with whose policy and attitude we are in entire accord, is the strongest evidence that our American friends not only believe in the great value of our properties, but in eventually arriving at a satisfactory settlement."

A FEW months ago I mentioned that the representatives of an American banking group had had a consultation in Paris with certain other persons concerning Russia's desire for a loan, and it is possible that the Russo-Asiatic Consolidated properties were involved. This does not seem quite to square, however, with what is mentioned in the opening sentence. What people are saying under their breath—though I have not been able to confirm it—is that the financiers behind the Lena Goldfields are after the Russo-Asiatic. Leslie Urquhart does not appear to be exactly *persona grata* with the Soviet leaders. The Russian government is keen on getting the mines worked, but not by the present management. Lena Goldfields has a working arrangement which in some respects is quite satisfactory; and there is American capital behind it. The suggestion now made is that the Lena people plus the American financiers will make a bid for the Russo properties. It is argued that the Russo-Asiatic, with Leslie Urquhart at the head, could find all necessary capital, and the fact that American financiers have approached him is taken as an indication that the rights may be transferred.

Another interesting matter in the mining world is the sharp rise that has taken place in San Francisco Mines shares. Metal prices would not explain it, and it is said that American financiers are buying because at the present level of around 3s. the interest yield is about 13 per cent.

Book Reviews

Resources of the South

NATURAL RESOURCES AND NATIONAL PROBLEMS. By Dr. Henry Mace Payne. American Mining Congress, Washington, D. C. Pages 63. Price 50c.

UNDEVELOPED MINERAL RESOURCES OF THE SOUTH. By Dr. Henry Mace Payne. American Mining Congress, Washington, D. C. Pages 368. Price $5.

FOR SEVERAL years the American Mining Congress has been endeavoring to stimulate public interest in the mineral resources of the South. Upon Dr. Payne, consulting engineer for the organization, the larger part of the burden of this task has fallen. The two volumes mentioned in the preceding paragraphs represent the culmination of this campaign. The shorter of the two deals with the economic questions involved in the development of a mineral industry, of course with special reference to the South, though with nation-wide application as well. Transportation and freight rates; taxation; public *vs.* private ownership; power development and super-power systems; labor and immigration—these are among the topics treated by Dr. Payne. His facts are interesting and his arguments for the most part sound.

The larger book is really an expansion of the first chapter of the smaller. Its title, "Mineral Resources of the South," indicates its nature. The occurrences of the various economic minerals are described briefly, and the extent of the producing industries is sketched. Names of companies are omitted, wisely under the circumstances. Dr. Payne says a word for tin, as a resource of the South. The keynote of such a book, of course, is optimism. Capitalists and others interested in the present industrial expansion of the South and those inhabitants of the Southern states who know of deposits of clay or other substances of which they are hopefully suspicious will find both books readable and of value for reference purposes.

A. H. HUBBELL.

THE ELEMENTS OF ECONOMIC GEOLOGY. By J. W. Gregory. E. P. Dutton & Company, New York. Pages 312. Price $3.25.

A COMPACT treatise such as this has its brevity to recommend it in addition to its intrinsic value. The author has confined his attention largely to those things that throw light on general principles, omitting reference to agencies and processes that are adequately dealt with in geological textbooks. He apologizes for "the apparent discourtesy of the dismissal of eminent opinion without due notice" and for "apparent dogmatism," and blames it all on the limitations of space. Dr. Gregory's dogmatic way of disposing of controversial topics is evident rather than apparent, but it serves at least to place his views definitely on record.

The 23 chapters of the book are grouped in five parts, under the headings: Introduction; Ore Deposits; Earthy Minerals; Engineering Geology; and Mineral Fuels. He considers together the various branches of civil and mining engineering and agricultural geology. Fourteen pages on the scope of economic geology and the search for ores and twenty dealing with the formation of deposits of useful minerals constitute the introduction.

Part IV, on Engineering Geology, comprises three chapters, respectively, on water supply; coast defence, coastal works and reclamation; and earthquakes and principles of anti-earthquake construction. The titles of the remaining three divisions already given indicate their nature.

A. H. H.

THE STORY OF GEOLOGY. By Allan L. Benson, Cosmopolitan Book Corporation, New York. Pages 300. Price $5.

MR. BENSON undertakes to explain the story of life, the earth, and the rest of the solar system to the man in the street. He was led to attempt this task, he says, by learning to his amazement that the layman could not place hands on a single book about geology suitable to his interest. In a way he is quite correct, for the average layman is too much of a dilettante outside of his particular specialty to undertake to read even the simpler textbooks. Mr. Benson has heightened the interest of his book by a flippancy that is frequently amusing. The volume is readable, although it is not recommended to geologists. For years geology has been a hobby of the author, so he is by no means on unfamiliar ground. He should be credited with having presented a racy sketch of geological theory. He displays good reasoning and considerable common sense. His style is simple. He avoids big words. He refers to the doctrine of isostasy without ever calling it by name. Minute examination of his statements will reveal to specialists inaccuracies that they may be inclined to quarrel over. They should bear in mind, however, that the book was not intended for them and that the layman will never know the difference.

A. H. H.

PETROLEUM FACTS AND FIGURES. Prepared by the Division of Public Relations, American Petroleum Institute, New York City. Comprises 264 pages.

Facts concerning the production, transportation, manufacture, and distribution of petroleum and its derivatives are set forth. Heretofore to obtain this information it has been necessary to resort to the reports and findings of numerous governmental, scientific, and commercial agencies. The reader will therefore find this compilation a valuable time-saver. The statistical tables and other data contained have been collected from all available sources. In some instances they are summaries of detailed statistics. The book is intended not only to serve as a convenient manual for reference, but also to acquaint the general public in its capacity as consumers and citizen taxpayers with the general facts and many of the essential particulars upon which the welfare of the petroleum industry depends.

NATIONAL ELECTRICAL SAFETY CODE. Fourth edition, 1926. Published by the National Bureau of Standards, Department of Commerce, Washington, D. C. Price $1.

This is a fourth edition of this volume. The revision has been made under the auspices of the American Engineering Standards Committee. It was carried out by two large and representative sectional committees, including delegates from all interested organizations, such as associations of utility companies, manufacturers, electrical workers, inspectors, insurance underwriters, technical experts, and administrative officials.

SOUTH AFRICA MINING.—The 1928 edition of the *South African Mining and Engineering Journal Year Book and Directory* has appeared. It may be obtained from the Argus South African Newspapers, Ltd., 72 Fleet St., London, England. Price 12s. 6d. This is an annual reference work on mining, engineering and allied industries. In its 590 pages are included the following: an analytical section; an engineering and industrial section; a railway and transport section; a Rhodesian and Congo section; and a mining section. It is to be noted that it does not confine itself to the mining industry by any means. It includes a list of foreign manufacturers represented in South Africa; one of British manufacturers and exporters to that country; also, a list of municipal, mining, railway and industrial buyers; and a list of the principal consulting engineers in South Africa and Rhodesia. A map of the Witwatersrand gold fields accompanies it.

ZINC—"Zinc and Its Corrosion Resistance" is the title of an 82-page bulletin recently issued by the American Zinc Institute, 27 Cedar St., New York. In this is presented in abstract form existing data concerning studies, investigations and tests, equipment and researches in the technical field of the use of zinc indicated by the title. The bulletin has been prepared under the direction of the Institute's Committee on the Development of Industry. Its price is $1 ($1.15 in Canada).

SHAFT SINKING—The sinking of the No. 11 shaft at McIntyre Mines, in the Porcupine district, Ontario, is described in the April *Canadian Mining and Metallurgical Bulletin* by H. A. Kee. The article comprises 18 pages with 2 inserts, one of these showing details of shaft timbering and the other containing a table summarizing the shaft sinking data compiled during the course of the work.

Personal Notes

IRA B. JORALEMON has returned to San Francisco from Cuba.

LETSON BALLIET, geologist and mining engineer of Reno, Nev., is in New York.

A. J. BEAUDETTE, mining geologist, has changed his address to 3939 West 27th St., Los Angeles, Calif.

FRANK D. PAGLIUCHI is in New York on business connected with his mining interests in Venezuela.

TUDOR TREVOR, secretary for mines and public works of Northern Rhodesia, recently left Cape Town for England.

SAMUEL SHAPIRA, mining engineer, recently returned to Boston after three months of exploratory work in Russia.

B. L. JOHNSON, of the U. S. Bureau of Mines, is making a detailed study of the phosphate resources of the South.

E. Y. DOUGHERTY is examining properties in Newfoundland. He may be reached at Box E5299, St. Johns, Newfoundland.

H. K. NAJARIAN, of the engineering staff of St. Joseph Lead, is now at Hughesville, Mont., in the interests of his company.

DAVID HILL is in charge of development at Grenfell Kirkland Gold Mines, which has recently been optioned by Buffalo interests.

R. J. BARBER has been appointed consulting engineer for North Fork Placers in Trinity County, Calif. M. A. SENGER is the superintendent.

E. POTTER SAWYER is in charge of operations at the properties of the Iroquois syndicate in the Kenora district, northern Ontario.

EARL M. SMITH, research engineer for Miami Copper, has resigned his position to become superintendent of the Belmont mill at Superior, Ariz.

JAMES WHITEHORNE, consulting engineer, who recently resigned from the Corner House staff, left Johannesburg recently on his way to England.

CARL O. LINDBERG, GEORGE L. JOHNSON, and C. H. PALMER have been made directors of Golden Centre Mines, which controls tin properties in Bolivia.

A. G. BURROWS, provincial geologist of the Ontario department of mines, is in charge of examinations of the zinc-lead-copper deposits in the Sudbury basin.

HENRY J. STEWART and W. J. HACKER have resigned their respective positions of consulting engineer and general superintendent for Jay Copper Gold Mines.

WILLIAM H. SCHACHT, vice-president of the Copper Range Company, is now in complete charge of the entire organization, including mines, mills, smelter, and railroad.

LIVINGSTON WERNECKE, manager of the Mayo properties of Treadwell Yukon, is in San Francisco. In making the trip, he traveled from Mayo to White Horse, Yukon, by airplane.

J. T. HARPER and A. R. TOWNE, representing New York interests, are making an examination of the properties in the Sudbury mining field of northern Ontario with a view to investment.

H. H. FRASER has been appointed manager of Loangwa Concessions, Ltd., which controls a consolidation of the Kasempa, Serenje, and Loangwa concessions in Northern Rhodesia, Africa.

N. L. STEWART, chief of the western engineering department of American Smelting & Refining, has returned to his headquarters at the Garfield smelter from a ten days' business trip to the East.

LLOYD C. WHITE, consulting engineer of San Francisco, has returned from the Sudbury district, where he went to attend the initial operation of the new mill of the Errington mine, which is owned by Treadwell Yukon.

A. B. YOUNG, assistant manager of International Smelting, arrived in Salt Lake City May 6 to resume his duties with the company, following six months spent on consulting work for the Cerro de Pasco Copper Corporation.

RONALD DRUMMOND passed through Salt Lake City on May 9 on his way to Winnipeg to join one of the Nipissing Mining Company's prospecting parties in the Flin Flon district. Mr. Drummond is the son of T. R. Drummond.

STEPHEN S. TUTHILL attended a conference in Cleveland recently on "Where Are the Competent Sheet Metal Workers of the Future Coming From?" He went from Cleveland to Washington to attend the national Chamber of Commerce meeting, where he represented the Zinc Institute.

B. B. THAYER, vice-president; J. R. HOBBINS, vice-president; FREDERICK LAIST, metallurgical manager; JOHN GILLE, mining engineer; and RENO SALES, chief geologist of Anaconda Copper, visited the Salt Lake district recently and inspected the Tooele smelter and the company's interests in the Tintic district.

LUCIEN EATON, superintendent of mines at Ishpeming, Mich., for the Cleveland-Cliffs Iron Company, arrived in New York on May 11 from Russia, where he has spent several months examining iron mining properties in the Krivoi Rog district, in the Ukraine, for Stuart, James & Cooke. He left New York the same day for Ishpeming.

W. A. WILSON, consulting mining engineer, of Salt Lake City, has returned to that city from a visit of two weeks to the property of the Silver Cord Mines Corporation situated at Ketchum, Blaine County, Idaho. While at the Silver Cord, Mr. Wilson inspected the results obtained by CARL W. CHILSON, who is studying the property with the Chilson geophysical prospecting equipment.

R. H. STEWART and H. L. BATTEN, who until recently were associated with the Victoria Syndicate, have opened offices in the Vancouver Block, Vancouver, B. C., as R. H. Stewart, H. L. Batten, and Associates. Colonel H. H. Yuill is now in charge of the activities of the Victoria Syndicate, which is operating the Lucky Jim, Hewitt, and Paradise mills, in the Kootenay district of British Columbia. Mr. Stewart will act as consulting engineer for the syndicate.

HENRY H. STORCH has been appointed supervisor of the U. S. Bureau of Mines experiment station at New Brunswick, N. J., where he will direct the potash research program, now pending the approval of the House of Representatives. Mr. Storch was born in New York in 1894. He was educated at the College of the City of New York and at the University of California. At the latter school he did graduate work in physical chemistry and was awarded the degree of doctor of philosophy. In 1916 he was employed at the Bureau of Standards in Washington as a junior chemist. Later he was employed by the Scoville Manufacturing Company as a research chemist. After serving in the army during the World War, he was engaged as an instructor at the College of the City of New York. He subsequently became identified with the faculties of M.I.T., University of California and University of Utah. In 1925 he was appointed chief chemist of the Burnham Chemical Company of Westend, Calif., where he was engaged in research work on the saline deposits of Searles Lake. For the last three years he has been a research chemist on the staff of the Roessler & Hasslacher company at Perth Amboy, N. J.

OBITUARY

A. H. ANDERSON, an old-time prospector, died at Dawson at the age of 79 on May 4. He was born in Ireland and was for many years engaged in mining in Montana, going to the Yukon in the early days of the gold rush.

JOHN TYLER JONES, a pioneer mining man of the Lake Superior district, died at Sharon, Pa., on May 4. He was 81 years old. Mr. Jones went to the Lake region from Pennsylvania in 1880 to assume charge of mining properties on the Menominee range. Later he was in charge of mines on the Mesabi range. He was the first to employ a steam shovel for loading iron ore direct from pit to car. For a number of years Mr. Jones carried on experiments with the Ardis furnace for the treatment of low-grade iron ores. Although the tests proved successful, the costs of the furnace were prohibitive. He retired from active participation in mining in 1920.

Market and Financial News

Utah Copper Reports $14,587,032 Profit Before Depletion for 1927

UTAH COPPER Company's annual report shows a net profit of $14,587,032, before depletion, largely the result of increased income from investments in other properties, in 1927, as against $13,809,310 in 1926 and $11,103,504 in 1925. Statement of operations for 1927 is given in the following table.

Operating Revenue:		
Copper produced—233,002,661 lb. @ 13.092c.		$30,503,937
Gold produced—89,303 oz. @ $20.00		1,786,065
Silver produced—795,888 oz. @ 56.40c.		448,901
		$32,738,904
Operating expenses:		
Mining, including stripping charge	$5,196,927	
Ore delivery—mine to mill	1,279,124	
Milling	6,247,273	
Treatment, freight and refining	6,006,237	
Selling expense	291,253	19,020,816
Profit from operations		$13,718,087
Miscellaneous income—net		3,264,623
Total income		$16,982,711
Charges against income:		
Depreciation	$1,241,946	
Plant and equipment retirements	237,198	
Federal income tax and other charges	916,534	2,395,679
Net income to surplus account		$14,587,032
Surplus from Operations		
Balance—Dec. 31, 1926		$51,639,467
Net income for year (without deduction for depletion)	$14,587,032	
Less—Additional capital stock taxes for prior years	405,892	14,181,140
		$65,820,607
Less:		
Dividends paid	$6,452,474	
Capital distributions	3,294,465	9,746,940
Balance of surplus—Dec. 31, 1927		$56,073,667

According to the statement of L. S. Cates, vice-president and general manager:

"The regular churn drilling campaign was continued during the year. There were completed seven holes having an aggregate depth of 4,566 ft. This work has partly developed the mining areas recently purchased and has extended the ore limits in the northwesterly portion of the property. Drilling work will continue in the future as orderly mining procedure demands.

"The ore reserves as of Dec. 31, 1927, amount to approximately 572,000,000 tons, averaging 1.1 per cent copper. To date a total of 159,586,151 tons of ore has been mined. The sum of the ore extracted and the remaining reserves, determined as above and without estimate of future development, indicate a basic resource of approximately 732,000,000 tons of profitable ore.

"There was mined and disposed of 7,293,784 cu.yd. of overburden. Of this, 492,078 cu.yd. was handled by contractors and the balance by the company. The yardage handled by the company was equivalent to 14,127,143 tons. Combining this with the 14,574,297 wet tons of ore mined makes the total tonnage of material loaded by company crews 28,701,440—an average of 83,922 tons per day for each actual operating day of the year. Mining operations were continued as in recent years in the upper portions of the orebody, as the ore remaining in the levels above the elevation of the original pit is producing all of the tonnage.

"A total of 13,811,500 tons of ore was mined and shipped to the mills. Leasers operating in the limestones in the southwestern portion of the mine produced 21,256 dry tons of copper and lead ores. The capping that has been removed since inception of operations has been dumped and stored in neighboring gulches. During the many years that a large portion of this material has been exposed to the elements the small amount of copper contained therein has become more thoroughly oxidized and water soluble. This condition has made it profitable to collect the meteoric waters that pass through the dumps and convey them to copper precipitating plants. During the past year 713,751 lb. of copper was so produced, in the form of precipitates, at a very low cost. As time goes on, the production of copper from this source will increase materially.

"The mining cost per ton of ore milled, including a proper apportionment of fixed and general charges (not including federal taxes and depreciation) was 37.34c. per ton. The actual direct mining cost of all ores was 18.00c., as compared with 18.89c. per ton for the previous year. Of the above direct mining cost of 18.00c. per ton, 12.91c. represents all mining charges and the balance, or 5.09c., fixed and general charges. The stripping charges absorbed into mining costs during the year amounted to 19.34c. per ton of ore mined. This amount covered the cost of all stripping actually removed during the year and an apportionment of similar charges, previously deferred.

"There were no major improvements installed at the mine during the year. The only new equipment acquired was an 85-ton combination trolley storage battery locomotive, which was purchased in order to determine whether the Diesel-electric or the trolley-electric locomotive will be the most economical to use when the present steam locomotive equipment is replaced. The substitution of steam by electric haulage throughout will begin during the current year. During the year twenty-nine houses were constructed at the new townsite at Copperton, making a total of forty-seven. This development has been greatly appreciated by employees and will be continued as appropriations are made available.

Milling Operations

"The tonnage of ore treated at the Magna and Arthur plants was 6,819,800 and 6,991,700, respectively, a total of 13,811,500, equivalent to an average of 40,385 tons per day for the actual number of days operating, or 37,840 tons per day if averaged over the full number of days of the year. The average copper content of the ore was 0.979 per cent or 19.6 lb. per ton, as compared with 1.01 per cent and 20.2 lb. for 1926. The metallurgical performance of the two mills was practically the same. The average recovery in the form of concentrates was 89.12 per cent, corresponding to 17.45 lb. of copper per ton, as compared with 87.01 per cent and 17.58 lb., respectively, for 1926. The average milling cost per ton of ore was 45c., a decrease of 3c. as compared with the previous year.

Gross Production and Costs

"The concentrates shipped to the smelter contained 240,964,666 lb. of copper, the average grade being 25.10 per cent as compared with 244,026,905 lb. and 17.07 per cent, respectively, for 1926. The precipitates derived from mine waters contained 713,751 lb. of copper and the productions from all sources, as compared with 1926, were as follows:

	1927	1926
Concentrates, lb.	240,964,666	244,026,905
Precipitates, lb.	713,751	756,380
Total	241,678,417	244,783,285

"After necessary allowances for losses in smelting and refining, the net production of refined copper for 1927 was 233,002,661 lb.

"The average cost per net pound of copper, including depreciation of plant and equipment and all fixed and general expenses, and after crediting gold, silver and miscellaneous earnings, was 7.54c. as compared with 7.94c. for the preceeding year, computed on the same basis. The value of the gold and silver recovered and the miscellaneous earnings amounted to 1.16c. per pound of copper, as compared with 1.36c. for the previous year."

The per ton operating costs on concentrating ore, including all fixed, gen-

eral and maintenance charges, are shown below, by periods, from 1910 to 1927, inclusive:

Years	Tonnage	Mining	Ore Delivery	Milling	Total
1910–1916	47,814,225	$0.3308	$0.2841	$0.3824	$0.9973
1917–1923	52,550,951	.4506	.2361	.8661	1.5528
1924–1927	52,356,500	.3460	.1093	.5153	.9706
1927	13,811,500	.3734	.0926	.4523	.9183

In summarizing general conditions, Mr. Cates states:

"In the past, progress in production has been largely the direct reflection of mechanical improvements at either the mine or the mills. The report for 1926 stated that the plants had a capacity for handling 50,000 tons per day when treating ores of an average grade milled during the then preceding two years. That capacity has been demonstrated for short periods and could be maintained indefinitely. No major improvements are contemplated, with the exception of the substitution of electric for steam locomotives at the mine.

"When costs are calculated on the same basis as in previous years, the cost per pound of producing copper in 1927 is the lowest in the company's history—the previous banner year being 1915, when the ore contained 28.5 lb. of copper per ton, as compared with 19.6 lb. per ton in 1927. The record is the more signal because, in the period under review, wages increased approximately 50 per cent, the cost of supplies 68 per cent, and taxes as a whole, 308 per cent over the rates obtaining in 1915.

"While, for the moment, it seems that future improvements may be of less effect, there will be no relaxation in the endeavors of the organization to maintain the company's splendid record made since its inception twenty-five years ago, when the present performance was deemed possible only by those whose creative genius laid the foundation of this enterprise."

Calumet & Hecla Report Indicates Increased Efficiency

CALUMET & Hecla Consolidated Copper Company reported net earnings, after depreciation and depletion, of $582,745 in 1927. Production of copper from the mines of the company amounted to 80,043,000 lb., produced at an average cost of 10.45c. per pound, not including charges for depletion and depreciation. Production from the reclamation plants at Lake Linden and Hubbell was 28,717,000 lb. of copper at an average cost of 6.63c. per pound. Earnings were affected by the low price of copper that prevailed throughout the year.

Increased metallurgical efficiency and decreased costs characterized the year's operation at the reclamation plants, which are summarized in the following table:

	1927	Since Starting
Tons treated	3,019,000	18,150,000
Assay headings, per cent.	0.574	0.669
Assay tailings, per cent.	0.093	0.154
Pounds refined copper	28,717,000	187,392,000
Pounds refined copper per ton treated	9.51	10.32

Of 1927 copper 6,791,000 lb. was from table treatment following grinding, 17,843,000 lb. from leaching, and 4,083,000 lb. from flotation.

Earnings Statement, Year 1927

Receipts		
Copper sales	$13,963,606	
Custom smelting	7,936	
Dividends	28,853	
Interest	245,959	
Miscellaneous	20,050	
		$14,266,406
Disbursements		
Copper on hand Jan. 1, 1927	$3,372,632	
Production	9,027,071	
Selling, administration and taxes	1,326,351	
Miscellaneous	259,383	
	$13,985,438	
Less copper on hand Dec. 31, 1927	3,650,171	10,335,267
Operating profit		$3,931,138
Depreciation	$1,442,083	
Depletion	1,906,310	3,348,393
Net profit carried to surplus		$582,745

New Cornelia Earned $3,138,772 Net in 1927

Net income of New Cornelia Copper Company for 1927 was $3,138,772 after deducting $438,940 for depreciation but before depletion.

Profit-and-Loss Account for 1927

Income		
Total earnings on metals	$10,363,610	
Dividends	40,701	
Interest	37,977	
Other income	30,755	
		$10,473,044
Expenditures		
Operating expenses	$4,551,724	
Salaries, office and general expenses	98,795	
Freight, refining and marketing	1,297,049	
State and federal taxes	947,763	
		6,895,332
		$3,577,712
Less depreciation		438,940
Net income		$3,138,771

Production of metals for 1927 and 1926 compares as follows:

	1927	1926
Copper, lb.	72,932,670	82,312,463
Silver, oz.	200,925	234,139
Gold, oz.	18,203	18,114

Maximum production in 1927 was not justified by market conditions.

Statistics of mine production are indicated in the following table, and include both ore and waste:

	Wet Tons	Dry Tons	Per Cent Copper
Total mined	4,433,098	.....	.....
To concentrator	2,320,190	2,291,188	1.421
To leaching plant	1,093,745	1,080,073	1.126
To low grade ore dumps	969,124	.....	.....
(sulphide)	123,212	.....	0.525
(carbonate)	845,912	.....	0.385
To waste dump	37,300	.....	.....

UNION MINIÈRE DU HAUT-KATANGA is offering £2,000,000 of 6 per cent sterling bonds in London at 99, to provide funds for the completion of the company's extensive metallurgical plant. Ore blocked out at the end of 1927 is estimated to contain 5,000,000 tons of metallic copper.

Nipissing Earnings Were Higher in 1927

NIPISSING Mining Company net earnings for 1927 were $347,059, an increase over the $164,311 earned in 1926. Reduced production costs, lessened expenditures on outside properties, and inventory adjustment are the factors credited for the increased income.

Statement of Operations for 1927

Gross settlements:		
Bullion, residue and silver ore shipments	.....	$1,176,278
Gross value of ore, bullion and residue at mine, Dec. 31, 1927	.....	808,989
		$1,985,268
Less gross value of inventory at mine Dec. 31, 1926	$849,168	
Gross value of custom bullion	9,979	859,147
Gross value of 1927 Nipissing production	.....	$1,126,120
Cost of mining and all other expenses (including smelter deductions and treatment on settlements 1927 ore and accrued charges on ore, bullion, and residue at mine)	$893,592	
Less other income at Cobalt	8,854	
Net cost of production	.....	884,737
Net income from 1927 production	.....	$241,383
Add interest on bonds	$111,442	
Interest on bank balances	15,655	
Profit on sale of securities	1,209	$128,308
		$369,691
Less—Cost of work on outside properties	.....	$22,632
Net profit	.....	$347,058
Surplus, Jan. 1, 1927	.....	3,318,928
		$4,165,987
Less dividends declared and paid during 1927	$390,000	
Dividends payable January, 1928	90,000	480,000
Net surplus—per balance sheet	.....	$3,685,987

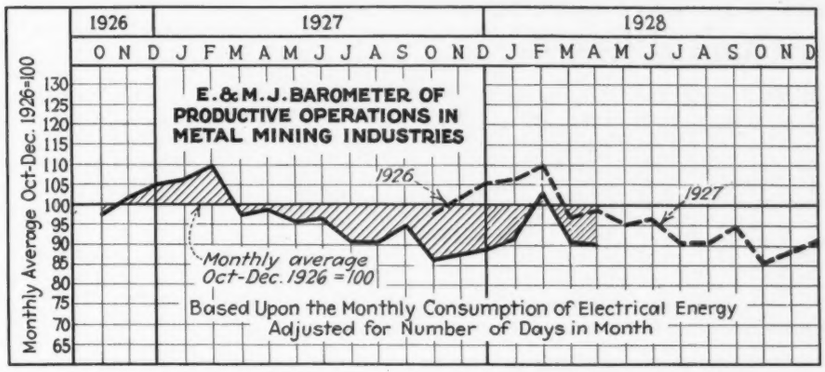
Production costs were 46.81c. per ounce of silver and $11.23 per ton of ore, compared with 51.48c. and $11.81 for 1926. From 78,767 tons of ore milled, 1,890,269 oz. of silver was produced, a decrease of 6,000 tons of ore and 50,000 oz. silver from the 1926 totals. Metal content of ore reserves was reduced by 109,000 oz. silver during 1927.

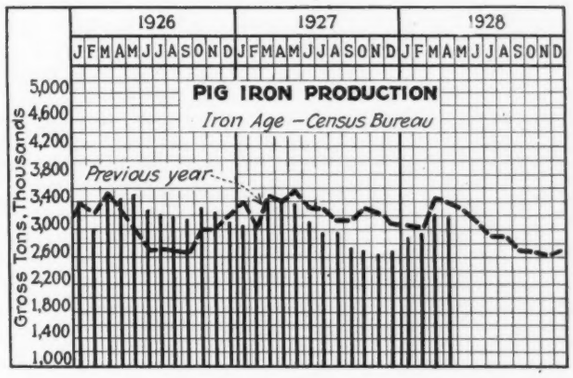
CERRO DE PASCO COPPER CORPORATION and its subsidiaries reports net income of $3,664,279 for 1927, after deducting all charges, equivalent to $3.26 per share earned on 1,122,842 shares of no-par-value stock. Net income after deduction of all charges, for 1926, was $4,550,837, or $4.05 per share. In 1927 Cerro de Pasco began to produce lead and zinc concentrates in commercial quantity and to turn out lead bullion.

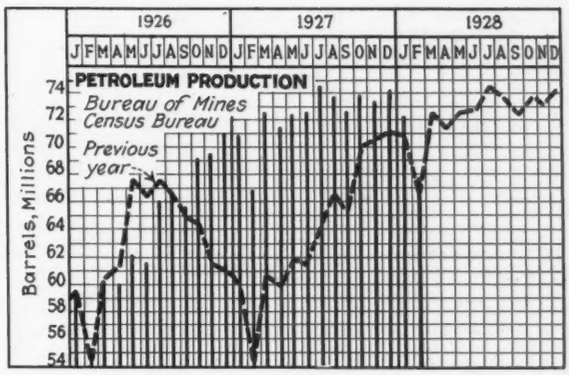
OLD DOMINION COPPER, operating in the Globe district of Arizona, reports a net loss of $276,841 for 1927, after all charges, including depreciation and depletion, which compares with a net loss of $109,698 in 1926. Production of smelting and concentrating ore decreased from 362,213 tons in 1926 to 356,697 tons in 1927, and the grade decreased from 3.94 per cent copper to 3.42 per cent copper.

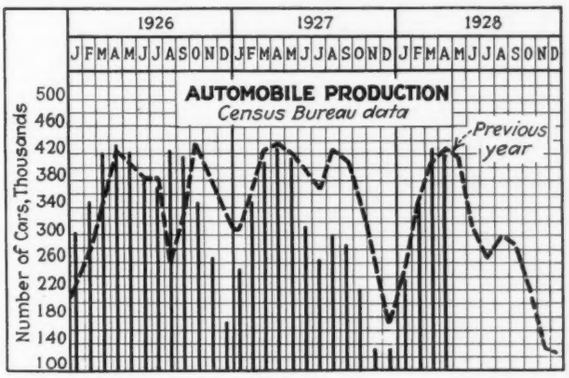
Indicators of Industrial Activity

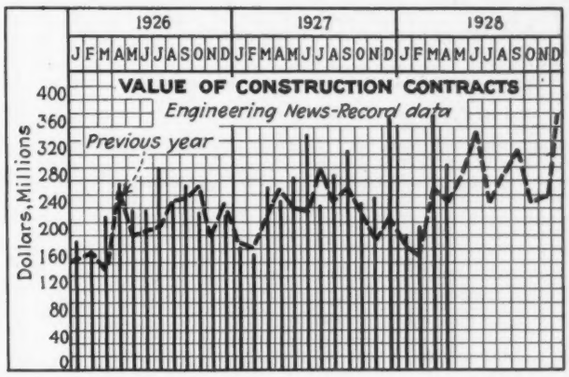
of Significance to Mining

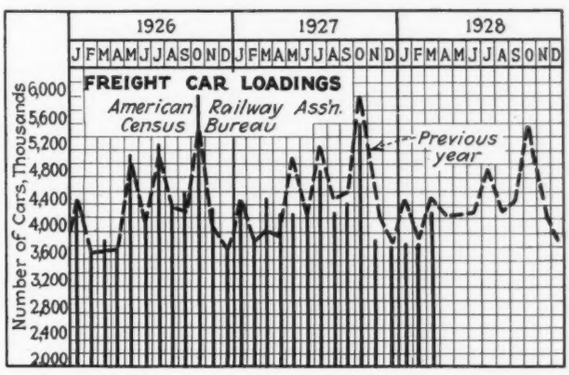

1926
1927
1928
O N D J F M A M J J A S O N D J F M A M J J A S O N D
Monthly Average Oct-Dec. 1926=100
130 125 120 115 110 105 100 95 90 85 80 75 70 65
E. & M. J. BAROMETER OF PRODUCTIVE OPERATIONS IN METAL MINING INDUSTRIES
1926
1927
Monthly average Oct-Dec. 1926 = 100
Based Upon the Monthly Consumption of Electrical Energy Adjusted for Number of Days in Month

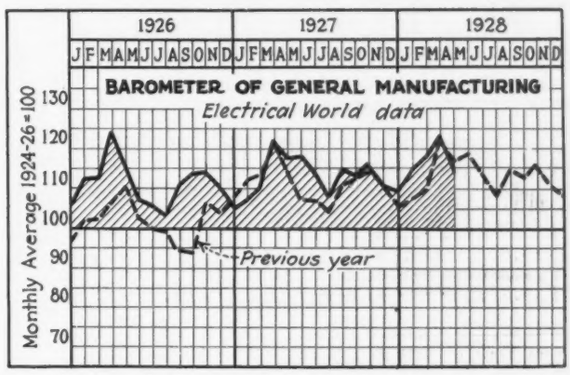

1926
1927
1928
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
Gross Tons, Thousands
5,000 4,600 4,200 3,800 3,400 3,000 2,600 2,200 1,800 1,400 1,000
PIG IRON PRODUCTION
Iron Age – Census Bureau
Previous year


1926
1927
1928
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
Barrels, Millions
74 72 70 68 66 64 62 60 58 56 54
PETROLEUM PRODUCTION
Bureau of Mines
Census Bureau
Previous year


1926
1927
1928
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
Number of Cars, Thousands
500 460 420 380 340 300 260 220 180 140 100
AUTOMOBILE PRODUCTION
Census Bureau data
Previous year


1926
1927
1928
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
Dollars, Millions
400 360 320 280 240 200 160 120 80 40 0
VALUE OF CONSTRUCTION CONTRACTS
Engineering News-Record data
Previous year


1926
1927
1928
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
Number of Cars, Thousands
6,000 5,600 5,200 4,800 4,400 4,000 3,600 3,200 2,800 2,400 2,000
FREIGHT CAR LOADINGS
American Railway Assn. Census Bureau
Previous year


1926
1927
1928
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
Monthly Average 1924-26=100
130 120 110 100 90 80 70
BAROMETER OF GENERAL MANUFACTURING
Electrical World data
Previous year

The Market Report

Higher Prices Feature Active Metal Market

New York, May 16, 1928.—An exceptionally active week in copper, with an advance in price; silver quoted at 60c. per ounce for the first time in nearly two years; and increased prices for zinc and tin are the high lights of the non-ferrous metal markets during the week ending today. The copper situation is well in hand, volume of sales continues large, and producers have advanced their price from 14¼c. to 14⅜c. per pound, delivered Connecticut Valley basis. Effective May 15, Copper Exporters, Inc., advanced its copper price from 14.50c. to 14.625c. per pound c.i.f. usual European destinations. Lead has been quiet, with a few sales at price concessions below the prevailing market levels. Tin is easy, with higher prices for spot metal. Quicksilver is firm at slightly higher prices. Cadmium has been in good demand with an advance in prices from 60c. to 65c. per pound. Platinum is unchanged.

Daily Prices of Metals

May	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
10	13.975@14.05	52.00	6.10	6.00	6.00
11	14.025	52.125	6.10	6.00	6.00
12	14.025	52.125	6.10	6.00	6.00
14	14.025@14.15	52.125	6.05@6.10	5.975@6.00	6.00@6.05
15	14.15@14.175	52.625	6.10	5.975@6.00	6.05
16	14.15@14 175	52.50	6.10	5 975@6 00	6.05
	14.079	52.250	6.096	5.994	6.021

Average prices for calendar week ending May 12, 1928, are: Copper, 14.021; Straits tin, 51.771; N. Y. lead, 6,100; St. Louis lead, 5.998; zinc, 5.977; and silver, 59.146.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted, and prices at so-called Middle West destinations, 0.325c. above.

Quotations for copper are for the ordinary form of wire bars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

May	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3M	Spot	3M	Spot	3M
	Spot	3M							
10	61 11/16	61 15/16	66½	234½	233½	20 5/16	20 5/8	26¼	25 7/8
11	61¾	62	66½	232 3/8	231¾	20 7/16	20¾	26 5/16	25 15/16
14	62 1/16	62 7/16	66¾	232¼	231⅝	20⅜	20 11/16	26¼	25 13/16
15	62½	62¾	67	232¾	232	20 5/16	20 11/16	26 5/16	25 15/16
16	62 9/16	62 13/16	67	232	231⅜	20⅜	20¾	26¼	25 13/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

May	Sterling Exchange "Checks"	Silver		Gold London	May	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
10	4.87 9/16	58¾	27 3/16	84s11½d	14	4.87¾	59⅝	27 7/16	84s11¼d
11	4.87¾	59¼	27⅜	84s11¼d	15	4.87 13/16	60	27 11/16	84s11¼d
12	4.87 13/16	59¼	27 5/16	.....	16	4.87¾	59¾	27½	84s11d
					Avg.		59.438		

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command seven-sixteenths cent premium.

Copper Active; Prices Higher

The past week has been one of great activity in copper. May metal is difficult to obtain, and is becoming more so as the large foreign demand for immediate shipment continues. In the domestic market, a huge volume of copper was sold last Thursday, and on Monday another period of intense buying activity was experienced. Several of the producers advanced their price for copper, delivered Connecticut basis, from 14¼c. to 14⅜c. per pound, late Monday, with no immediate slackening in demand. On Tuesday all sales agencies were asking 14⅜c., although the buying wave was then tapering off. Foreign deliveries have also been exceptionally good. It is estimated that shipments since May 1 for foreign consumption have been about 90,000,000 lb. North and South American stocks of blister and refined copper show a reduction of more than 21,000 tons. Domestic production, reduced to a daily tonnage basis, for April is but slightly higher than in March. Present condition of refinery stocks is the result of recent hand-to-mouth buying practice of consumers.

Lead Quiet and Steady

In contrast to the active business and buoyant prices in copper, the lead market is colorless. Inquiry has been better the last few days, but the total volume of sales is scarcely up to the average. Although there has been a little shading of prices, the market seems fairly steady, and a small net gain in London during the week has given sellers confidence. The prevailing price in the Middle West has been 6c., although several good sales were made at 5.975c., and it is rumored that some small lots are looking for a buyer at 5.95c. Cable makers are the most prominent buyers. In the New York market the American Smelting & Refining Company has continued its contract price at 6.10c., and other producers for the most part have been at that level. Deliveries are for prompt and June, with practically none farther ahead.

Substantiation of the contention that mine production has been markedly curtailed appears in the A. B. M. S. statistics for April, wherein it is shown that crude production in the United States and Mexico declined 10,000 tons, which, taking into account the short month, is a reduction of 10 per cent in the rate of output.

Zinc Prices Higher

The condition in the zinc market during the past week is but a repetition of the story of previous weeks, with slightly different figures. The tendency of prices continues upward, and volume of sales continues below the average. That sentence expresses the essence of

the situation. Tri-State producers continue to keep close grasp of their production. Smelters have been forced to meet the prices of the ore producers in order to keep their retorts in operation. The following statistics in tons of 2,000 lb. have been released by the American Zinc Institute:

Stock April 1	41,529
Produced	53,493
	95,022
Shipped	50,263
Stock, April 30	44,759
Shipped from plants for export.	3,746
Metal sold, not yet delivered, at end of period	20,925
Total retort capacity at end of period	122,920
Number of retorts operating at end of period	72,522

Prompt Tin Up

Though there is no shortage of prompt tin in warehouses and on dock in New York, the supply is held almost entirely by one interest, and it is taking advantage of this position to put up the price for metal for prompt delivery. Spot is consequently quotable at about 1c. higher than future. In London both prompt and three-month positions are materially lower than a week ago. The season of active demand on the part of tin-plate makers is over for the present, and in the absence of speculative support in London a decline in prices would not be surprising.

Silver High and Strong

The silver market was active during the week, advancing steadily to May 15th to 60c., but has since reacted slightly, being quoted today at 59⅜c. The cause of the advance was due to a good demand from China and heavy buying by India for spot delivery. The closing tendency is uncertain.

Mexican Dollars (Old Mexican pesos): May 10th, 45⅛c.; 11th and 12th, 45⅝c.; 14th, 45⅞c.; 15th, 46¼c.; 16th, 46c.

Foreign Exchange Dull

Little change in the markets for foreign exchanges is noted for the week. Closing cable quotations on Tuesday, May 15, were as follows: Francs, 3.93¾c.; lire, 5.27c.; and marks, 23.935c. Canadian dollars were quoted at ¾ per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c.

ANTIMONY—Per lb., duty paid. New York: Chinese brands, for all positions. 11¼c. Market stronger after slight reaction.

Cookson's "C" grade, spot, 15⅜c. Needle antimony nominally 7½c. for lump and 10c. for powdered. White oxide, Chinese, 99 per cent Sb_2O_3, 11½c.

BISMUTH—Per lb., New York, in ton lots, $2.10. Smaller lots, $2.25 and up.

CADMIUM—Per lb., New York: Price advanced from 60 to 65c., effective May 12.

IRIDIUM — Per oz., $275@$300 for 98@99 per cent sponge and powder. Market dull, prices largely nominal.

NICKEL—Per lb. ingot, 35c.; shot, 36c.; electrolytic, 37c. (99.9 per cent grade) for single lots of spot metal.

PALLADIUM — Per oz., $46@$49. Small lots bring up to $55. Absolutely no activity in market.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $78. Dealers and refiners quote the trade for refined metal, per oz., cash, for wholesale lots, $73.50@$74 bid, $75.50@$76.50 asked. Market very quiet.

QUICKSILVER — Per 76-lb. flask, $123@$124, depending on quantity. San Francisco wires $124.

Prices of Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Tungsten, and Zirconium are unchanged from the issue of May 5.

Metallic Ores

MANGANESE ORE—Per long ton unit of Mn, c.i.f. North Atlantic ports, minimum 47 per cent Mn; 35@38c. Caucasian, washed, 53@55 per cent, 38@40c. Chemical grades unchanged from quotations in the May 5 issue.

TUNGSTEN ORE—Per unit of WO_3, N. Y.: Wolframite, $10.55@$10.75. Western scheelite, $10.60@$10.75.

Chrome, Iron, Tantalum, and Titanium ores are unchanged from quotations in the May 5 issue.

Zinc Shipment Increased—Purchase Decreased

Joplin, Mo., May 12, 1928

Blende

	Per Ton
High	$41.40
Premium blende, basis 60 per cent zinc	$39.00@41.00
Prime Western, basis 60 per cent zinc	39.00
Fines and slimes, 60 per cent zinc	36.00@38.00
Average settling price, all zinc	37.70

Galena

High	$79.00
Basis 80 per cent lead	77.50
Average settling price, all lead	76.33

Shipment for the week: Blende, 12,842; lead, 2,586 tons. Value, all ores the week, $569,380.

Sellers generally declined to accept the same price this week, asserting that the metal market warranted a higher basis price, but buyers continued firm throughout the day, and would offer no price higher than $39 basis for Prime Western grades.

The shipment was increased 2,000 tons, but was almost 3,000 tons short of the purchase last week. With what can be purchased today, this will give shippers a fair tonnage for shipment next week.

Platteville, Wis., May 12, 1928

Zinc Blende	Per Ton
Blende, basis 60 per cent	$41.75
Lead Ore	
Lead, basis 80 per cent lead	$78.50

Shipments for the week: Blende, 800 tons; lead, 40 tons. Shipments for the year: Blende, 14,007 tons; lead, 840 tons. Shipments for the week to separating plans, 1,072 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, Tripoli, and Zircon are unchanged from prices in the May 5 issue.

Metallic Compounds

ARSENIOUS OXIDE (White Arsenic)—Per lb., 4c. Market quiet.

Calcium Molybdate, Copper Sulphate, Sodium Sulphate (Salt Cake), Sodium Nitrate, and Zinc Oxide are unchanged from prices in the May 5 issue.

Ferro-Alloys

FERROMANGANESE—Per long ton, domestic and foreign, f.o.b. furnace or duty paid, port of entry, $105 quoted for second quarter, 1928. Spiegeleisen, 19@21 per cent, $32 f.o.b. furnace.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent, 92@95c. f.o.b. works.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium, and Ferrovanadium are unchanged from prices in the May 5 issue.

Metal Products

ROLLED COPPER—Sheets 23c.; wire advanced from 16 to 16½c. per lb., May 15.

YELLOW (MUNTZ) METAL—Dimension sheets, 20c. from 19¾c. per lb.; rods, 17c. from 16¼c. per lb., May 15.

Lead Sheets, Nickel Silver, and Zinc Sheets are unchanged from prices in the May 5 issue.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the issue of May 5.

Iron, Steel, and Coke

Iron—Per gross ton, Valley furnaces, Bessemer, $17.50; basic, $16.25@$16.50; No. 2 foundry, $17.25.

Steel—Base prices per gross ton, Pittsburgh, billets and slabs, $33; plates, structural shapes, and soft steel bars, per pound, 1.85@1.90c.

Coke—Per gross ton, Connellsville furnace, contract, $2.75@$3; spot, $2.50@$2.75. Connellsville foundry, contract, $3.75@$4.25; spot, $3.60@$4.25. By-product coke, Ohio and Kentucky, $7; Buffalo and Detroit, $8.50@$9.

Mining Stocks—Week Ended May 12, 1928

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	72¼	69⅝	71	Ap.14, My.21 Q	0.75
Ariz. Com'l	Boston	4⅛	3⅛	4⅛	Ja. 19, Ja. 31 SA	0.25
Cal. & Ariz	New York	105½	101½	102	Ma. 3, Ma. 19 Q	1.50
Calumet & Hecla	Boston	23⅝	22⅛	23⅛	Fe. 28, Ma. 15 Q	0.50
Cerro de Pasco	New York	69⅜	67	68	Ap.12, My.1 Q	1.00
Chile Copper	New York	43⅛	42	42¼	Jn.6, Jn.30 Q	0.62½
Con. Coppermines	N. Y. Curb	15	13	14		
Copper Range	Boston	20⅜	18	20	Ma. 24, Ap. 20 A	1.00
Crystal Copper	Boston Curb	1 1/16	*90	*95		
East Butte	Boston	3	2½	2⅝	Dec., 1919	0.50
Granby Consol	New York	64⅜	49½	53	Ap.13, My.1 Q	1.00
Greene Cananea	New York	126	116⅛	122½	Nov., 1920	0.50
Howe Sound	New York	60⅜	56	59⅞	Ma.31, Ap.16, Q	1.00
Inspiration Consol	New York	22⅞	21½	22⅜	Apr. 1927 Q	0.25
Isle Royale	Boston	18⅛	14⅜	18	Fe.28, Ma.15 SA	0.50
Kennecott	New York	89⅛	87½	88⅞	Ma. 2, Ap. 2 Q	1.25
Magma Copper	New York	50½	48½	49⅛	Ma.31, Ap.16 Q	0.75
Mason Valley	N. Y. Curb	1¼	1¼	1¼		
Miami Copper	New York	19⅜	19	19⅛	My.1, My.15, Q	0.37½
Mohawk	Boston	58⅛	54⅜	57½	Ap. 30, Jn. 1 Q	1.00
Montana-Idaho	Spokane	*32½	*30	*30½		
Mother Lode Coal	New York	4	3⅜	4	De.16, De.31 SA	0.25
Nevada Consol	New York	23⅛	22⅜	23⅜	Ma.16, Ma.31 Q	0.375
New Cornelia	Boston	28⅛	27⅛	28	My. 4, My. 21 Q	0.50
Noranda	N. Y. Curb	21	18½	20½		
North Butte	Boston	2⅛	2⅛	2⅛	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*85	*80	*80	Sept., 1926	0.03
Old Dominion	Boston	13⅜	11	13⅜	Dec., 1918	1.00
Phelps Dodge	N. Y. Curb	131	125	131	Ma.20, Ap.2 Q	1.50
Quincy	Boston	35½	23	35	March, 1920	1.00
St. Mary's Min. Ld	Boston	31¼	26	31	Ap.1928 A	2.00
Seneca Copper	New York	2⅜	2⅛	2⅛		
Shattuck-Denn	N. Y. Curb	23½	20½	22⅜		
Tenn. C. & C	New York	14⅜	12⅞	14	Ma.29, Ju.15,Q	0.12½
United Verde Ex	N. Y. Curb	23	19⅜	21⅛	Ap.6, My.1, Q	0.50
Utah Copper	New York	150	145	146	Ma.16, Ma.31 Q	1.50
Utah Metal & T	Boston	1⅛	1¼	1⅛	Dec., 1917	0.30
Walker Mining	Salt Lake	*85	*80	*84		
NICKEL-COPPER						
Internat. Nickel	New York	95⅜	90	93	Ma.15, Ma.31Q	0.50
Internat. Nickel pfd	New York	...	..	115	Ap.12, My.1 Q	1.50
LEAD						
Gladstone Mtn	Spokane	*7½	*7	*7	June, 1927	0.005
National Lead	New York	130	127	127	Ma.16, Ma.31Q	1.25
National Lead, pfd. A	New York	...	...	147	Ju.1, Ju.15 Q	1.75
National Lead, pfd. B	New York	...	...	120½	Ap. 23, My. 1 Q	1.50
St. Joseph Lead	New York	40⅞	39¼	40½	Jn.9, Jn.20, QX	0.75
ZINC						
Am. Z. L. & S	New York	26	24⅜	24⅜	May, 1917	1.00
Am. Z. L. & S. pfd	New York	88	86	87½	Nov., 1920	1.50
Butte C. & Z	New York	6	5⅞	5⅞	De., 1926	0.50
Butte & Superior	New York	11⅛	10	10⅛	Ma.14, Ma.31 Q	0.50
Callahan Zn-Ld	New York	4	3½	3⅜	De., 1920	0.50
Consol.Lead&Zinc 'A'	St. Louis	15	12½	14⅜	Ap., 1927	0.25
Eagle-Picher	Cincinnati	17	16	16½	No.15, De.1 Q	0.40
Eagle-Picher pfd	Cincinnati	103¾	103	103	Ma. 31, Ap. 16 Q	1.50
New Jersey Zn	N. Y. Curb	236	212	220	Ap. 20, My. 10 Q	2.00
Treadwell-Yukon	Toronto	21.00	20.00	20.00		
United Zinc	N. Y. Curb	*75	*55	*55		
Yellow Pine	Los Angeles	...	...	*32	Dec., 1925 Q	0.04
GOLD						
Alaska Juneau	New York	4⅛	3⅞	4⅛		
Argonaut	Toronto	*10¾	*8	*8¼		
Barry-Hollinger	Toronto	*85	*75	*83		
Central Manitoba	Toronto	1.30	1.26	1.27		
Con.W.Dome L. new	Toronto	*11	*10	*11		
Cresson Consol. G	N. Y. Curb	1 1/16	1⅛	1 1/16	Ma.31, Ap.10 Q	0.10
Dome Mines	New York	9⅜	9⅛	9⅛	Ma.31, Ap.20 Q	0.25
Golden Cycle	Colo.Springs	†1.77	†1.74		Fe.29, Ma.10 Q	0.04
Gold Hill	Toronto	*18	*15	*15½		
Hollinger Consol	Toronto	16.25	15.00	16.10	My.2, My.19	0.10
Homestake Mining	New York	72	72	72	My.19, My.25 M	0.50
Kirkland Lake	Toronto	1.84	1.76	1.78		
Lake Shore	Toronto	23.50	22.60	22.60	Ma.1, Ma.15QX	0.20
McIntyre Porcupine	New York	26½	25½	26½	May1, Ju.1 Q	0.25
Portland	Colo.Springs	†*20	†*16	...	Ap., 1927	0.02
Rand Mines	New York	...	...	44	Fe.21-28 Am.Sh.	1.52
Sylvanite	Toronto	3.25	3.10	3.10		
Teck-Hughes	Toronto	9.50	9.18	9.20	Ja. 17, Fe. 1 X	0.15
Tom Reed	Los Angeles	*52	*42	*42	Dec., 1926	0.02
Tough-Oakes	Toronto	*38½	*31	*32½		
Vipond Cons	Toronto	*61½	*58½	*60	April, 1927	0.03
Wright-Hargreaves	Toronto	4.60	4.37	4.50	Ap.13, My.1 Q	0.05
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	24⅜	24⅛	24⅛		
Con. Cortez	N. Y. Curb	*31	*29	*29		
Dolores Esperanza	N. Y. Curb	1⅜	1	1⅛	July, 1923	0.05
N.Y. Hond's Rosario	N. Y. Curb	16⅛	16⅛	16⅛	Ap.18, Ap.28 Q	0.50
Premier Gold	N. Y. Curb	2 7/16	2⅜	2⅜	Ma.15, Ap.4	0.08
Tonopah Belmont	N. Y. Curb	1 1/16	*90	1	Oc., 1925	0.05
Tonopah Extension	N. Y. Curb	*15	*11	*15	Ap., 1925	0.05
Tonopah Mining	N. Y. Curb	4⅜	4	4⅜	Mar.31, Ap.21 SA	0.07½
West End Consol	N. Y. Curb	...	...	*4	Mar., 1923	0.05
Yukon Gold	Boston Curb	*73	*62	*73	June, 1918	0.02
SILVER						
Beaver Consol	Toronto	1.41	1.33	1.37	May, 1920	0.03
Castle-Trethewey	Toronto	*65	*57	*61½		
Coniagas	Toronto	5.25	5.11	5.11	May, 1924	0.12½
Keeley	Toronto	*60	*60	*60	Ma.1, Ma.15 SA	0.04
Lorrain Trout Lake	Toronto	...	...	*30	July, 1925	0.05
Mining Corp. Can	Toronto	3.49	3.22	3.42	Ja.10, Ja.25 SA	0.75
Nipissing	N. Y. Curb	4⅛	4⅛	4⅛	Ma.31, Ap.20Q	0.07½

Stock	Exch.	High	Low	Last		Last Div.
SILVER-LEAD						
Ahumada	New York	5¼	4⅛	4⅛	Ap., 1927	0.12½
Bingham Mines	Boston	50	49	50	Ma.22, Ap.5 Q	1.00
Bunker Hill & Sullivan	N. Y. Curb	...	...	137	Ap.30, My.4 MX	0.75
Cardiff M. & M	Salt Lake	*74	*71	*73	Feb. 5, 1927	0.10
Chief Consol	Salt Lake	4.45	4.12	4.12½	Ja.10, Fe.1 Q	0.10
Consti'nMng.&Mill'g	Spokane	*11	*8	*10		
Erupcion	Boston Curb	*35	*35	*35	Dec. 13, Jan. 3,	0.07½
Eureka Lily	Salt Lake	2.35	2.10	2.35		
Federal M. & S	New York	125	125	125	Je., 1927	10.00
Federal M. & S. pfd	New York	97	95½	97	Fe.24, Ma.15 Q	1.75
Hecla Mining	N. Y. Curb	15⅞	14⅜	15⅜	My.15, Jn.15 Q	0.15
Highland-Surprise	Spokane	*13½	*10	*13½		
Iron King Mining	Salt Lake	*68	*63	*68		
Keystone Mining	Salt Lake	†1.32½	†1.25	...	Fe., 1926	0.07½
Lucky Jim	Spokane	*36	*33	*34½		
Lucky Tiger-Com	Kansas City	†7.85	†7.50	...	My.10,.My.19MX	0.07
Mammoth Mining	Salt Lake	†2.00	†1.50	...	De., 1926	0.25
North Lily	Salt Lake	8.50	7.75	8.40		
Park Utah	New York	13	12	12½	Ma.15, Ap.15 Q	0.20
Plutus Mining	Salt Lake	1.75	1.75	1.75	Ap.10, Ap. 16 Q	0.10
Silver King Coal	Salt Lake	12½	11⅜	12½	Ma.20, Ap.2 Q	0.25
Silversmith	Spokane	*20	*18	*20	Oct., 1926 Q	0.02
Strattons Mines	Spokane	*50	*45	*50		
Sunshine M. Co	Spokane	1.48	1.43	1.48	Fe.10, Fe.20	0.10
Tamarack-Custer	Spokane	*85	*80	*83	Sept., 1924	0.25
Tintic Standard	Salt Lake	14	13½	14	Ma.21, Ma.29Q	0.30
Utah-Apex	Boston	4⅛	4⅛	4⅛	Oct., 1926	0.25
IRON						
Bethlehem Steel	New York	63⅞	60⅛	62	Jy., 1924	1.25
Cleveland-Cliffs Iron	Cleveland	120	100	117	Ap.13, Ap. 25. Q	1.00
Colorado Fuel & Iron	New York	76⅜	74	74⅞	May, 1921	0.75
Gt. North'n Iron Ore	New York	23⅜	22⅛	22⅛	Ap. 9, Ap. 30 K	0.75
Inland Steel	New York	56⅛	55	55⅛	My. 15, Jn.1 Q	0.62½
Republic I. & S	New York	61⅜	59⅛	60⅜	My.15, Jn.1 Q	1.00
Republic I. & S. pfd	New York	107	106⅛	107	Jn. 15, Jy. 2 Q	1.75
Sloss-Sheffield S. & I	New York	122	117	121	Ma.10, Ma.20 Q	1.50
Sloss-Snef. S.&I. pfd	New York	...	...	122½	Ma. 20, Ap. 2 Q	1.75
U. S. Steel	New York	150⅜	145⅛	145⅝	My.31, Jn.29 Q	1.75
U. S. Steel, pfd	New York	145⅜	144⅛	145⅛	Ap. 30, My. 29 Q	1.75
Virginia I. C. & C	New York	...	...	31⅞	Jan., 1924	1.50
Virginia I.C.&C. pfd	New York	58	57	57	De. 16, Ja. 3 SA	2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM, TIN						
De Beers Consol	New York	28⅜	27⅛	28⅜	Jy., 1927	1.45
So. Am. G. & P. New	N. Y. Curb	3⅜	3⅛	3⅛		
Alum. Co. of Amer	N. Y. Curb	172	149½	172		
Alum. Co. of Amer. pf.	N. Y. Curb	110½	109⅜	110	Ma. 15, Ap. 1 Q	1.50
Vanadium Corp	New York	91⅜	84⅛	86⅛	My. 1, My. 15 Q	0.75
Patino M. & E	New York	39⅞	35⅛	39⅛	April, 1928	4s.
ASBESTOS						
Asbestos Corp	Montreal	39	35	36½	Jan., 1926	1.50
Asbestos Corp. pfd	Montreal	95	94½	95	Ma. 31, Ap. 16 Q	1.75
SULPHUR						
Freeport Texas	New York	75	68⅜	73½	Ap.14, Ma.1 QX	1.75
Texas Gulf	New York	73⅜	71⅛	72½	Ma. 1, Ma. 15 Q	1.00
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	48⅜	46⅞	47⅜	My.15, Jn.1	0.75
Amer. Metal, pfd. 6%	New York	116½	116	116	My.15, Jn.1	1.50
Amer. Met. pfd. 7%	New York	126¾	126⅜	126⅜	My.15, Jn.1	1.75
Amer. Sm. & Ref	New York	193	189⅛	191⅛	Ap.13, My.1 Q	2.00
Amer. Sm. & Ref. pfd	New York	140⅜	138⅜	138⅜	My. 4, Jn. 1 Q	1.75
Consol. M. & S	Montreal	278	274	275	De. 31, Ja. 16 X	6.25
Newmont Mining	N. Y. Curb	187	174	179	Ma.31, Ap.16 Q	1.00
U. S. Sm. R. & M	New York	45⅛	44	44⅛	Ap.5, Ap.14 Q	0.87½
U.S. Sm. R.&M. pfd	New York	54⅛	53⅞	54⅛	Ap.5, Ap.14 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. A, Annual. SA, Semi-annually. M, Monthly. K, irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, J. A. Hogle & Co.; Colorado Springs, Colo., Henry Sachs.

LONDON QUOTATIONS—WEEK ENDED May 1, 1928

Name	High	Low	Last	Date	Amount	Last Div.
Alaska Mexican ($5)	41/6	40/—	40/—			
Alaska Treadwell ($25)	135/6	135/—	135/—	Nov., 1926	4 ($)	
Aramayo Mines (25 frs.)	73/9	70/—	71/3	May, 1928	5 p.c. (†)	
Burma Corpn. (10 rupees)	13/10½	13/3	13/7½	Jan., 1928	6 annas*	
Bwana M'Kubwa (5s)	5/—	4/6	4/9			
Camp Bird (2s)	5/4½	4/3	4/9	April, 1928	16⅔ p.c.	
El Oro (£1)	4/9	4/6	4/6	Nov., 1924	2½ p.c.*	
Frontino & Bolivia (£1)	14/6	13/9	13/9	Jan., 1928	5 p.c.	
Mexican Corpn. (£1)	11/—	9/4½	11/—			
Mexico Mines of El Oro (£1)	37/6	35/—	53/—	Dec., 1926	3⅛ p.c.*	
Mond Nickel	187/6	157/6	181/3	Feb., 1928	7½ p.c.	
N'Changa Copper Mining	11/—	10/—	10/—			
Oroville Dredging (£1)	4/—	3/9	4/—	Dec., 1923	3⅛ p.c.	
Rhodesian Congo Border (£1)	22/9	19/4½	20/—			
St. John del Rey (£1)	12/6	11/7½	12/—	April, 1928	7½ p.c.	
San Francisco Mines (10s)	31/—	28/—	31/—	Jan., 1928	25s.	
Santa Gertrudis (£1)	17/—	15/9	16/—	Jan., 1928	7½ p.c.	
Selukwe (2s. 6d.)	12/3	11/4½	11/4½	April, 1917	6¼ p.c.	
S. Amer. Copper (2s.)	3/3	2/6	3/1½	Nov., 1917	75 p.c.	
Tanganyika (£1)	67/6	60/—	63/9	Aug., 1927	7½ p.c.	
Union Miniere de Haut-Katanga (Brussels)	8,300	7,712.50	8,200	July, 1927	182.60 (‡)	

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian frs. and free of taxation. §U. S. Dollars.